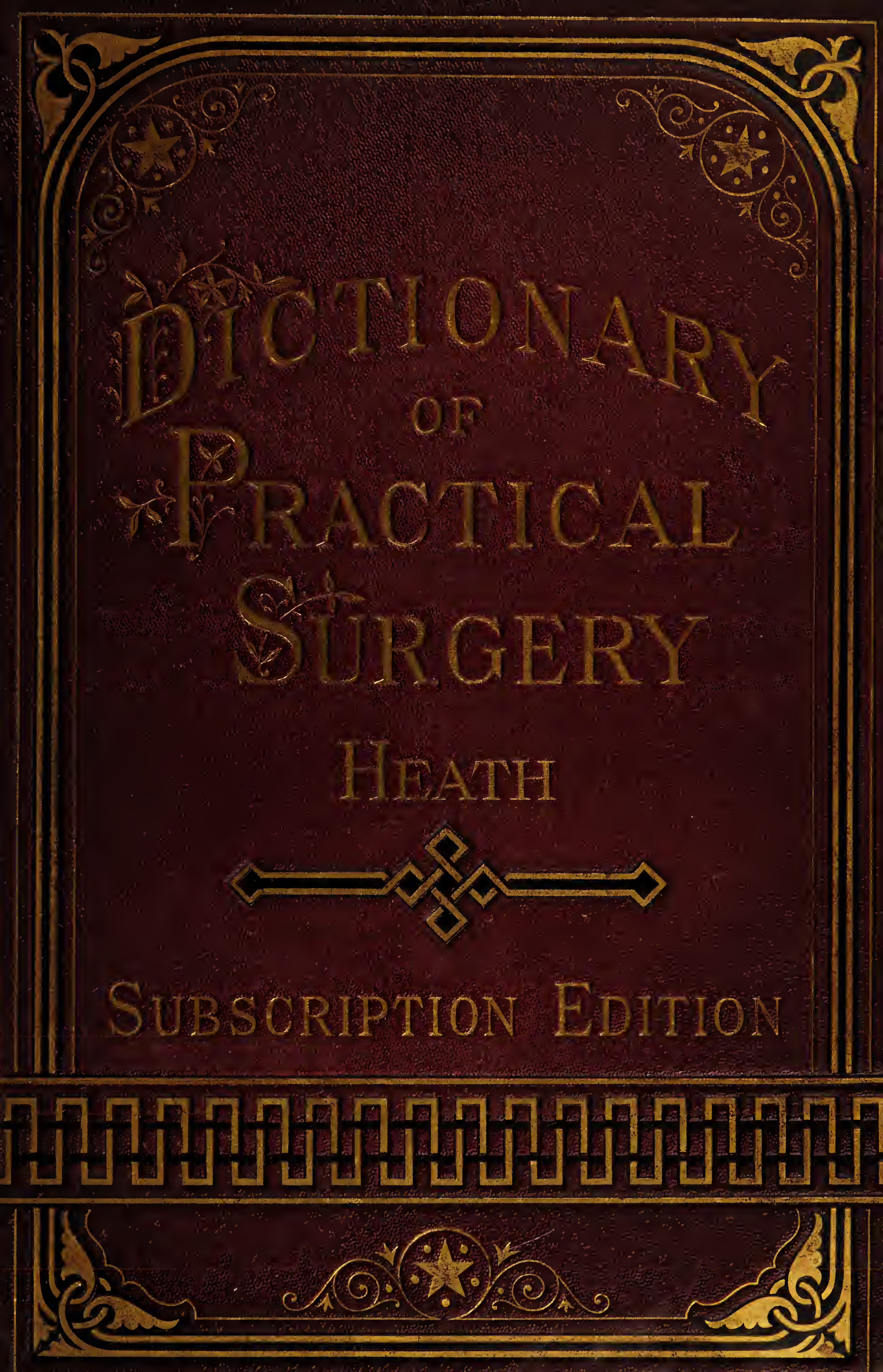

DICTIONARY OF PRACTICAL SURGERY

HEATH

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DICTIONARY

OF

PRACTICAL SURGERY

BY

VARIOUS BRITISH HOSPITAL SURGEONS

EDITED BY

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In perforating wounds of the skull, it may be necessary to trephine in order to reach fragments of the internal table, which is always more extensively comminuted and depressed. The bullet at the same time may be discovered. In cases where fracture of the internal table only is suspected, a diagnosis cannot be made, and expectant treatment must be adopted. In contusion or wound of the brain, the chief thing is to purify the part thoroughly, keep the patient at rest on a low diet, and apply cold to the head. Beyond this, there is in the first instance but little to do, and later on but little can be done. Should an abscess form, the evacuation of the pus affords the only prospect of recovery.

In cases of compression, when the symptoms are due to hæmorrhage, an attempt may be made to discover the source of the bleeding, and for this purpose the external wound may be enlarged and also that in the bone. The blood-clot, however, should not be interfered with. In progressive hæmorrhage blood-letting is sometimes useful. The ligature of the common carotid on the injured side is an operation likely to be of only temporary benefit. Where the symptoms of compression depend on depressed fracture, the depressed fragments of bone should be elevated or removed.

Gunshot Injuries of the Spine.—In these, as in head injuries, the matter of first importance is the degree of damage to nerve-tissue. Injury of the spine is very generally complicated with wounds of the chest, neck, or abdomen. Otherwise the mortality varies with the part of the spine wounded. The higher up the injury is, the greater the mortality. Gunshot fracture of the spine is always serious, especially when it involves the bodies of the vertebræ. When recovery does take place, the transverse or spinous processes are alone affected. Concussion of the spine and temporary paralysis may be produced by shell-explosion, but frequently some further injury has been inflicted. Wounds of the spine from heavy projectiles nearly always prove rapidly fatal. Very few injuries of the cervical spine have recovered, and in these the injury was confined to the spinous processes, and was followed in all the cases by stiffness of the neck, with paralysis of the arm.

Associated with gunshot injury of the dorsal spine there is frequently a penetrating wound of either the chest or abdomen, followed by speedy death. When the processes or laminæ only are involved the fatal termination is protracted, death taking place from secondary causes. Recovery most frequently ensues in fractures of the lumbar spine. Seventy cases were observed in the American war, but in these the processes of the vertebræ were the parts injured. In many, paralysis continued for the remainder of life; in others there were repeated abscesses, exfoliations of bone, and sinuses. In a few cases the bullet lodged either in the spinal canal or the bone. In three-fourths of the cases of fracture of the spinal column the cord was injured at the same time. There are, however, no reliable statistics of the frequency of the various kinds of injury. The symptoms may be immediate or secondary, and their character will depend on the portion of the cord injured. They may come on after an interval of weeks, months, or even years.

In some cases the cord will be merely contused, a kind of injury more frequent than is commonly supposed, producing symptoms dependent on the particular region involved. In other cases the cord may be compressed by an extravasation of blood, or a fragment of bone, or an embedded projectile. Here, also, the symptoms will depend on the particular part which has been wounded. In a few cases, when the cord has not been permanently damaged, if the cause of the compression can be removed recovery may follow; but in those cases which do not terminate fatally the usual result is permanent paralysis, complicated by bedsores and chronic catarrh of the bladder. When the injury is inflicted from behind, the gunshot track will be short; but from in front it is necessarily long, and the nature of the injury difficult to diagnose, complicated as it probably will be with perforating wound of the thorax or abdomen. The cord may be either partially or completely divided, and there will always be more or less extravasation of blood. When the cord is completely divided, the reflex excitability will be increased. The nature and extent of the paralysis are generally sufficient to establish a diagnosis.

With injury in the region of the lumbar spine there will be loss of sensation and motion in the lower extremities, retention of urine in the first instance, followed by stillicidium, incontinence of fæces, and priapism. The upper extremities are unaffected.

In the dorsal region there is dyspnœa from paralysis of the abdominal and intercostal muscles, and if the lesion be in the upper part of dorsal spine, the upper extremities are involved as well. The temperature in the paralysed parts is at first increased. The functions of the bladder and rectum are generally interfered with; priapism is infrequent; bedsore is prone to form at all points where pressure exists.

In the cervical region the upper and lower extremities are paralysed, there is difficulty of swallowing, difficult respiration; inequality of the pupils is occasionally observed; there may be increase of temperature in the paralysed parts.

Injury to the cord itself is fatal sooner or later almost without exception,—in the upper cervical region, after a very few days, from interference with respiration; in the lower, seldom later than the first week. Only in the lumbar region may the patient live a few months. Death generally takes place from suppurative meningitis or from exhaustion.

GUNSHOT INJURY OF NERVES.—Wound of the cerebral nerves is very rare, except in conjunction with other severe injury. Branches of the fifth are sometimes wounded, and also the facial nerve. The pneumogastric has been sometimes divided in the neck, generally with an immediately fatal result, from wound of the adjacent vessels; otherwise the respiration becomes slow and laboured, the voice is lost, the pupil on the injured side contracted, and pneumonia supervenes.

In wounds of the extremities, the great nerve-trunks, as a rule, escape; they are elastic and protected by their sheath, but one of them may be lacerated, completely divided, or more or less contused. In these cases, if any foreign body be found pressing on the nerve, it must be removed. If the nerve be wholly or partially divided, the seat of injury should be exposed; the injured part must be excised, and the cut ends sutured together with fine carbolised silk, as was first recommended by Nélaton in 1864. It does not seem a matter of much importance whether the suture be passed merely through the sheath, or through the nerve-substance as well. Restoration of function has followed in a large proportion of cases. In some, atrophic changes have occurred even after apparent recovery. Where the first attempt ends in failure, a second may be made. Galvanism should be employed at an early period to stimulate the atrophied muscles. The frequency of injury to the nerve-trunks is much greater in the upper than the lower limb. In the latter the sciatic nerve is most frequently damaged, in the former the brachial plexus or median nerve.

GUNSHOT WOUNDS OF THE EYE.—During the Franco-German war these amounted to 10 per cent. of the total number of wounds. In regard to impairment or loss of function the vulnerability of the eye stands high. It may be directly injured by the projectile, or contused or burst through the medium of adjacent parts. If penetrated by a pellet of shot or fragment of bullet, the sight is invariably lost, either by the escape of the contents of the eyeball through the wound, or the subsequent intense inflammation which sets in. The sight is, as a rule, destroyed by gunshot injuries; a less severe injury may induce traumatic cataract, iritis, or glaucoma. Sympathetic inflammation of the other eye is a frequent and serious result of damage to one. Gunshot injury, as a rule, destroys the eye, and enucleation becomes necessary to avert the occurrence of sympathetic ophthalmia.

GUNSHOT INJURY OF THE EAR.—These injuries are very rare, and are usually associated with damage to other organs. In some cases the sense of hearing is temporarily or permanently damaged by the explosion of shells in close proximity, causing rupture of the membrana tympani. In a few cases the mastoid cells have been opened, or a fracture traverses the middle ear. The ear has frequently been injured by wounds inflicted from the mouth. Inflammation and suppuration in the bone are frequent and dangerous consequences, as the inflammation may spread inwards at any time to the brain. The external ear may be torn off in part or altogether. The detached portion should be sutured. After gunshot injury, however, the damaged portion generally sloughs off.

GUNSHOT WOUNDS OF THE FACE.—Very extensive wounds of the nose and cheek, followed by great deformity, are the result of gunshot injury. Much may be done to relieve the condition of the patient by subsequent plastic operation. Lacrymal fistula may occur, or fistula from injury to Steno's duct, or facial paralysis from division of the portio dura. Gunshot fracture of the upper jaw is a serious accident. Death from hæmorrhage frequently occurs in the first instance, and pyæmia and erysipelas, sinuses with prolonged discharge, and exfoliation of necrosed bone are common after-consequences. Gunshot fracture of the lower jaw is three times more frequent, and in some respects more serious, than fracture of the upper jaw. The large number of cases recorded, however, in the American reports, prove the risk of life to be about equal in the two forms of injury, the mortality after gunshot wound of the upper jaw being 8·1 per cent., and of the lower jaw 8·3.

Any loose fragment should in the first instance be removed; a piece of moulded pasteboard applied over the chin and secured by a four-tailed bandage. Suppuration is always abundant, but extensive necrosis is rare. The mouth should be frequently washed out; iodoform is an excellent application in all cases of buccal wound.

Secondary hæmorrhage has proved exceedingly frequent and difficult to control, after injury to the face. The carotid artery has been tied in many instances, but the result has been most unsatisfactory, the hæmorrhage usually recurring and causing a fatal termination. The mortality after ligature amounts to more than 70 per cent. In a few cases the external carotid has been ligatured successfully.

GUNSHOT WOUNDS OF THE NECK.—Those of the lateral aspect may involve the great vessels; the pneumogastric or sympathetic nerves from behind. Unless deep enough to involve the spine, a gunshot wound here is comparatively unimportant. In front the hyoid bone, the larynx or trachea, may be injured; and in a few cases the pharynx or œsophagus. Where the air-passage is opened the symptoms are evident. Air escapes from the wound, and probably there is emphysema in the neck. Power of speech would be lost, there would be difficulty of breathing and swallowing, and risk of asphyxia from inflammatory swelling, or from deep-seated inflammation in the neck. Laryngeal or tracheal stenosis may occur from subsequent cicatricial contraction, necessitating tracheotomy and the permanent wearing of a canula. The prognosis is in these cases unfavourable.

In all cases of injury of the larynx and trachea the patient must be kept quiet; sudden œdema may necessitate tracheotomy. When a foreign body in the neighbourhood of these organs interferes with respiration, and cannot be safely removed, the earlier tracheotomy is done the more favourable is the prognosis. Superior tracheotomy is the easier method. An elastic catheter, a drainage-tube, or the end of a large silver catheter, may be used in case of need in place of a canula.

Gunshot wound of the œsophagus is very rare, and nearly always associated with damage to other important structures in the neck. The bullet may traverse the tube, making two openings in it, or tear a portion completely away. Fracture of the spine, and injury to the cervical vessels and nerves are frequent complications. Swallowing is usually very difficult or impossible. The prognosis is bad, death taking place from hæmorrhage, asphyxia, or, at a later period, from diffuse cellulitis in the neck, pneumonia, secondary hæmorrhage, or exhaustion. A few have recovered with a permanent fistula and traumatic stricture. In gunshot wounds of the œsophagus the nutrition of the patient is the chief difficulty. He should be fed by the mouth if possible, or else through the wound with a tube.

GUNSHOT INJURIES OF THE THORAX.—The proportion of these to the total number of wounds varies in different wars from 1 in 10 to 1 in 16. The latter was the proportion in the Crimea. In the American war it was 1 in 12. In 1870, before Metz and Strasburg, it was 1 in 12. The ratio of non-penetrating to penetrating wounds varies from 25 to 53 per cent. In the Crimea penetrating wounds amounted to 31 per cent. of the chest wounds, during the American war to 42 per cent., and among the Prussian wounded in 1864 to 53 per cent. During the war of 1870–71 different observers estimated the percentage at from 44 to 89 per cent. The nearer the hospital is to the battlefield, the more numerous the penetrating wounds of the chest received into it will be.

In uncomplicated gunshot wounds of the superficial parts covering the chest the mortality is very small, probably not more than one per cent. They seldom occasion much pain or cause implication of the lung. They heal slowly, on account of the mobility of the chest-wall, especially when of the variety called seton wounds. It is not uncommon to find the ball or fragments of cloth or other foreign substances lodged. In a certain number of cases the ribs were injured without opening the pleural cavity, or directly injuring its contents. In many instances these cases did well, but they were often complicated with pleuritis or pneumonia from the irritation of the fractured bone, or abscess and necrosis taking place. The scapula and clavicle as well as the ribs may be fractured without the pleura being penetrated.

PENETRATING WOUNDS OF THE CHEST.—Penetrating wounds may take place either with or without fracture of the ribs. The projectile, when small, may pass between two ribs without injuring them. This was found to be not infrequently the case with the chassepôt bullet during the war of 1870, but the needle-gun bullet invariably fractured the ribs, and so did the Russian Berdan ball. Fracture of the ribs at the entrance-wound takes place in the majority of cases, and greatly enhances the severity of the injury, as fragments of bone are generally carried in with the ball and seriously damage the lung. At the wound of exit fracture of the rib is of less importance. In a few cases the pleura has been found wounded without injury to the lung. Several cases of this kind were observed during the war of 1870. It is probably caused by the bullet striking tangentially or at a slow velocity. Klebs mentions a case in which the ball traversed the right pleural capity, entering in front on a level with the fourth rib and emerging opposite the tenth, behind, without wounding either the lung, pericardium, or diaphragm. The nature of such an injury would be impossible to diagnose during life.

Penetrating gunshot wounds of the chest may not only be associated with fracture of the ribs, but very frequently with fracture of the scapula as well; less commonly, the sternum or clavicle. Fractures of these bones are very serious complications, as fragments of them often lie embedded in the lung and produce most extensive suppuration. The bullet may traverse one pleural cavity from side to side, or both pleuræ. It may lodge in the lung-tissue, the wall of the chest, or the body of a vertebra; or pass through the diaphragm and wound the abdominal viscera.

The diagnosis of a wound penetrating the pleural cavity and wounding the lung, which it does in the great majority of instances, is generally sufficiently clear. Air passes in and out through the wound. There will be always more or less dyspnœa present, and in some cases this is exceedingly urgent. Hæmoptysis is by no means a constant symptom of wounded lung. Probably it does not occur in more than one-fourth of the cases; indeed during the American war it was, it is stated, present in only five or six per cent., but when observed it will afford valuable, although by no means conclusive, evidence of the nature of the injury. Pneumothorax is always present, and collapse of the lung, unless the pleural surfaces be adherent at the seat of injury. Hæmothorax is an almost constant consequence of injury to the lung. It is very variable in amount; in many cases it will be very slight, from the collapse of the lung closing the wounded vessels, in others the blood may fill the pleural cavity.

The symptoms of hæmothorax are frequent laborious respirations and orthopnœa. There is urgent anxiety and distress, the patient turns about or can only rest on the injured side; great sense of constriction around base of chest. There is also evidence of loss of blood, pallor, cold surface, frequent small pulse, or there may be complete collapse. The percussion note is dull and the respiratory murmur absent, the ribs separated, the hypochondrium prominent. Surgery has hitherto availed but little to relieve the urgency of the symptoms. The question of reopening the wound or keeping it closed is a disputed one. Cold should be applied to the chest and warmth to the extremities. Only when the symptoms become very urgent should the wound be reopened. The intrathoracic pressure may of itself stop the bleeding. Subsequent symptoms must be treated as they arise. Emphysema after penetrating wounds is uncommon, occurring perhaps once in every 200 cases. It is usually limited to the neighbourhood of the wound; very rarely is it of any great extent.

The fatality of penetrating gunshot wounds is very great. A large proportion quickly die upon the field. Where both pleural cavities are involved, or the heart or its great vessels wounded, death will be always instantaneous. Amongst those treated in hospitals, more than half terminate fatally in the first few days from acute inflammatory processes in the lung and pleuræ; others who survive this period die from fever and exhaustion, the result of the septic changes in the fluid contained in the cavity of the wound; while in many cases of so-called recovery there are sinuses constantly discharging, necrosis of portions of rib, empyema, chronic cough, and other evidence of lung-mischief. The mortality probably is not less than 70 to 75 per cent.

In a few favourable cases the wound will heal under a scab, and this led to the practice, proposed by Surgeon Howard during the American war, of hermetically sealing perforating gunshot wounds of the chest. All accessible foreign bodies and fragments of bone having been removed, the edges of the wound are pared, sutured together, and covered with lint saturated in collodion. In 69 cases treated in this way, the lung being wounded in all but 15 of them, recovery took place in 27—a mortality of 68 per cent. The mortality is not, perhaps, excessive, especially as two-thirds were believed to be associated with lung-injury; but the American reporter thinks that, in many of these cases, the evidence of wounded lung and perforation of thorax is quite insufficient; besides, in many of the so-called cases of recovery, interminable sinuses, necrosis, empyema, chronic cough, and other evidence of lung-mischief remained. Sometimes occlusive treatment relieved the dyspnœa and the more urgent primary symptoms, with temporary improvement as a result. But the careful examination of the evidence proves that this plan has not lessened the mortality, and has been sometimes attended by disastrous consequences. Fragments of clothes and other foreign bodies are sewn up, and blood and fluid accumulate and decompose in the interior.

The fatality of gunshot wounds really perforating the lung is very great. In unfavourable cases pneumonia follows more frequently than is commonly supposed, though by no means invariably, especially where foreign bodies have entered and air gains free admission. It is very fatal when it takes place. In 20 autopsies by Klebs of gunshot wound of the lung, pneumonia was only once observed. Probably this is due to the collapse of the organ. In other instances an abscess develops which may open into a bronchus and the patient recover, or burst into the pleural cavity and produce septic pleuritis. Gangrene of the lung is rare. Inflammation of the pleura is often more serious than inflammation of the lung, as it so generally assumes a septic form, or an empyema develops, accompanied with hectic fever and rigors.

Hernia of the lung, the result of gunshot injury, is very rare. Only 7 examples are noted amongst 20,000 cases of chest wounds. No case was observed during the Franco-German war. The explanation of its occurrence is difficult and unsatisfactory. The tumour moves with the act of respiration. Reduction without excision cannot be accomplished. An intercostal omental hernia may be mistaken for pneumatocele. The better course is to leave the tumour alone without active surgical interference. It may be protected subsequently with a hollow pad, or retract spontaneously. Cases of hernial protrusion of the liver and omentum have also been observed. Wounds of the diaphragm never unite. If recovery ensue, a diaphragmatic hernia will occur.

Immediate Treatment of Gunshot Injuries of the Chest.—If the wound is small, the injury to the bone not great, and no foreign body has been carried in, the best course will be to treat by antiseptic occlusion. If extensive, with much injury to the bone, loose fragments and foreign bodies are to be removed, counter-openings made, free drainage provided for, and antiseptic dressing applied. If this fail, frequent washing out of the cavity with warm salicylic solution must be adopted. The same rules apply for the extraction of foreign bodies here as elsewhere. If the projectile be lodged in the wall of the chest, it may be removed; if within the cavity, no attempt to extract it or to examine the wound with a sound should be made.

The patient must be kept very quiet, in a moist, warm atmosphere. A half-sitting posture is a good one, with the body turned to the injured side. Transport is impracticable. Formerly, copious blood-lettings were practised; but this is undesirable, unless the dyspnœa go on increasing and is not relieved by subcutaneous injections of morphia. The quantity of blood removed should be in proportion to the strength of the patient. In constantly increasing hæmothorax bleeding has been practised, but it is better to lay the patient on the injured side, close the wound, and apply ice to the chest. To open the cavity and evacuate the blood would probably renew or increase the bleeding. If the extravasation decompose, free incisions and drainage must be resorted to. Opium administered internally gives great relief in these cases. Emphysema does not often cause great dyspnœa; it may be relieved by small punctures. Pneumothorax had best be let alone; in extreme cases the wound may be opened again.

Hæmoptysis requires rest, nourishing diet, styptics, and opium internally, and cold to the chest. Serous effusions are seldom observed, except after contusions. The treatment will be expectant in most cases, or simple puncture if the effusion be great and cause severe symptoms, or is not absorbed after a few weeks. Traumatic empyema is more common. For this condition free drainage and antiseptic irrigation must be practised. Generally two openings are required. Excision of the ribs is a very old operation, seldom applied to cases of military surgery as a primary operation. It will often prove useful in cases of empyema. A piece of one or more ribs may be excised for the purpose of securing a freer opening; the cavity must be daily washed out with warm salicylic solution and antiseptic protection given. Sometimes the cure is rapid; generally it is slow, with associated curvature of the spine and falling in of the chest-wall. A fistula often remains open for a long period. In two instances in which the writer treated a gunshot penetrating injury of the chest by excision of a rib for subsequent empyema, the result proved most satisfactory. *See* EMPYEMA.

GUNSHOT INJURIES OF THE ABDOMEN.—These may take the form of contusion, or of wound involving the parietes only, or, lastly, be penetrating, a variety which forms more than half the total number. The projectile may penetrate and lodge, traverse the abdomen and emerge by a second wound, or become arrested at some point beneath the skin. As a general rule the viscera will be injured; in a few cases they escape. Abdominal wounds may be complicated with injuries of the chest or pelvis. Contusions occur from the blow of a spent shot, and may occasion extravasation in the abdominal wall or cavity. Laceration of the viscera occurs in about 1·5 per cent. of these cases. The liver or spleen is the organ generally affected. The only treatment is an expectant one, as an accurate diagnosis is scarcely possible. Wounds of the parietes may be simple or severe. Their chief importance consists in an associated injury to the viscera, or the spread of subsequent inflammatory processes in the interior of the abdomen.

The symptoms of injury to the intestine are often indefinite. The contents of the bowel may or may not escape externally. There is always more or less extravasation into the abdominal cavity, which usually sets up a rapidly fatal peritonitis, accompanied by great pain, tympany, vomiting, hiccough, and collapse. In some few rare cases the extravasation may become encapsuled, and an abscess forms, followed by fæcal fistula. The diagnosis of the exact extent of the injury is scarcely possible, short of making an abdominal section. The great majority prove fatal in twenty-four or thirty-six hours. During the American war the mortality was 83 per cent.

Gunshot wounds of the large intestine do not present any special symptoms. They are less dangerous than those of the small intestine, because the injury is sometimes extra-peritoneal, and, especially in the descending colon, recovery may ensue after the formation of a fæcal fistula. Recovery is rare after injury of the ascending or transverse colon. Gunshot wounds of the rectum are not uncommon. They are usually complicated with fractures of the pelvis or wound of the bladder. The writer remembers cases of this kind in which fæcal matter escaped from the posterior wound and urine from the anterior. Recovery sometimes takes place, but diffuse pelvic suppuration is apt to be induced, and both primary and secondary hæmorrhage are very frequent. In cases which do survive, fistulous openings persist for a long period.

Gunshot wounds of the stomach are usually immediately followed by vomiting of blood, severe collapse, epigastric pain, intense thirst, hiccough, and extravasation of blood; the escape of the contents of the stomach will depend on its empty or distended condition at the moment of injury. The stomach is seldom wounded alone, the lungs and diaphragm, liver, spleen, or colon being generally also wounded. The injury, as a rule, proves rapidly fatal. A few well-authenticated cases of recovery are recorded. Six are mentioned in the American report, and Fischer exhibited a stomach at the meeting of German surgeons in Berlin, with a circular cicatrix caused by a bullet in the central part of the anterior and posterior surfaces. The patient died of an attack of cholera two years after having recovered from a gunshot perforation of the stomach. In some cases, as that of Alexis St. Martin, recovery is followed by a permanent gastric fistula.

GUNSHOT INJURIES OF THE LIVER.—This organ may be subcutaneously ruptured by a blow from a heavy projectile. Bullets may produce wounds of almost any extent or variety. The convex surface is generally most frequently injured, and in some cases these wounds may be recovered from. Wounds of the concave surface are almost immediately fatal. Death occurs from severe hæmorrhage or rapid peritonitis. In cases which are not immediately mortal an abscess will form. The older surgeons considered this injury as fatal as a wound of the heart; but Otis has proved that in a few instances of undoubted injury to the liver recovery has taken place. Generally a fatal result sooner or later ensues, as the injury is seldom confined to the liver itself. Where the gall-bladder is wounded death has almost always followed.

GUNSHOT WOUNDS OF THE KIDNEY are not very common, from its deeply-placed, protected situation. As in the large intestine, the injury may be either intra- or extra-peritoneal. The wound may involve the cortical portion, the pelvis, the renal vessels, or all of these parts. The termination is generally fatal from peritonitis and hæmorrhage, but a number of recoveries are recorded. Urinary fistula and exhausting suppuration continue for a long time. The prognosis is bad, although the injury is probably less fatal than that of the liver or spleen. The chief symptoms are hæmorrhage from the wound, blood in the urine, shock, pain in the loins and testicle, and an area of dulness in the region of the kidney. Persistent vomiting is frequent.

In the first instance expectant treatment is to be recommended for wounds of the kidney. Many cases of injury to the kidneys during the last wars have recovered. Care must be taken that the secretions are allowed to escape freely, the interior of the wound must be cleansed with carbolic injections; perinephritic abscesses diagnosed as early as possible and opened by lumbar incision. Where the suppuration surrounds the entire kidney, or septic symptoms appear, it may be best to extirpate the organ. *See* NEPHRECTOMY.

GUNSHOT WOUNDS OF THE BLADDER may occur in those parts invested by peritoneum, or be extra-peritoneal. The former prove rapidly fatal; of the latter a certain proportion recover. Excluding those who die on the field, 65 deaths (according to Bartels) took place in 285 cases. The wound may either traverse or merely penetrate the bladder. Wounds from before backwards and from behind forwards occur with almost equal frequency. The latter appears to be the more dangerous, and a traversing wound than a single opening. All cases in which the peritoneal cavity was involved proved fatal, and a large proportion of the others died from urinary infiltration and septic poisoning. About one-half are complicated with fracture of the pelvis, which considerably increases the risk of life. The pubic bone is most frequently involved, next the sacrum, then the ilium, and least frequently the ischium. In many cases the projectile, a piece of clothing, or fragment of bone lodges in the bladder. If recovery ensue, these become encrusted with triple phosphates and give rise to symptoms of calculi. Gunshot wound of the bladder is attended by the escape of urine mixed with blood from the wound, by vesical tenesmus, great pain in the abdomen, groin and testicle; fever sets in on the second or third day, and urinary infiltration followed by septic suppuration takes place in the pelvic cellular tissue.

It is essential in the treatment of bladder wounds to make provision for the escape of urine; otherwise we adopt expectant treatment. The rapidly fatal nature of the injury when the peritoneal cavity is involved does not permit an exploratory operation to be performed. A permanent catheter should not be left in the bladder, because it induces bladder-catarrh and ulceration of the mucous membrane. Fistulæ often persist after recovery, and are difficult to treat or cure.

A foreign body in the bladder should be removed at once. Its presence, however, is often not recognised till a later period. Then it may be removed through the wound after enlarging it, or by lithotomy. The function of the bladder is often permanently damaged.

Mortality.—In the field-hospitals the mortality from perforating gunshot wounds of the abdomen is at least 80 per cent., and a large number die from injury to the abdomen on the field. In respect of mortality, the individual organs stand in the following order:—The most fatal is injury of the small intestines, next the stomach, the spleen, large intestine where invested by peritoneum, liver, kidneys, large intestine outside the peritoneum, lastly the rectum. Hæmorrhage is the most frequent cause of death; some appear to die from shock. If the first period be survived, septic absorption and general peritonitis, still later secondary hæmorrhage and exhaustion, are the causes of a fatal termination.

Treatment of Injuries of Abdomen and Pelvis.—Gunshot wounds involving the parietes only should be treated antiseptically, as similar wounds elsewhere. When the peritoneum is simply opened, an effort should be made to close it by suture. Any uninjured organ which may protrude should be cleansed and returned. Protrusion of the abdominal contents after gunshot injury is very rare. The traumatic peritonitis which so commonly ensues may be treated by ice, calomel and opium internally, but this will be all but useless. Effective drainage, combined with antiseptic washing out of the abdominal cavity, making, if necessary a free incision through the parietes for the purpose, affords better prospects, but hitherto these injuries have been almost uniformly fatal. Isolated collections of pus should be freely opened and drained. Simple blood extravasation should not be interfered with.

When the stomach is wounded, the hæmorrhage is always most serious, and there is the additional risk of extravasation of its contents. When a diagnosis can be made, the existing wound in the parietes should be enlarged, or an incision of sufficient length made in the linea alba; then after the wounded organ is fully exposed the stomach must be drawn out and the wound in it closed with a double row of sutures; the peritoneal cavity must afterwards be thoroughly cleansed with a warm antiseptic solution. The external wound can now be sutured, and the part dressed antiseptically. Nothing should be given by the mouth for some days, and the strength maintained by nutrient enemata. Opium must be freely administered. Although in civil hospitals operations on the stomach have proved successful, a like result is improbable in time of war. Recovery is, however, possible. A gastric fistula is an unfavourable result, as it is exceedingly difficult to cure, and interferes with the nutrition of the patient. A flap of skin may in some cases be transplanted in order to close it, or the abdominal wall incised, the adherent stomach separated, and the opening in it closed by Lembert's sutures, then the margins of the fistulous track in the parietes must be pared and united. Several cases of recovery are recorded after this operation. It was first performed by Billroth.

Gunshot wounds of the intestine seldom come under treatment, or only too late for effective interference. Where the injured intestine is prolapsed and the wound in it small, we may close the opening by suture, and carefully cleanse all the parts before reduction. In cases where an injury to the intestine is diagnosed, the patient should no longer be left without an effort made to preserve life. An incision must be made in the median line, or the existing wound may be enlarged sufficiently and a search made for the injured bowel. This must then be dealt with according to the amount of damage it has sustained, either by simple suture of the opening when it is small, or when more extensive by resection of the damaged portion of bowel and suture of the cut extremities together by Lembert's method. It will be necessary to take care not to detach the mesentery from the intestine and thus rob it of its vascular supply. Where any considerable part of the intestine requires removal a V-shaped portion of mesentery must be excised. Then the edges of the bowel and the cut margins of the mesentery are sutured together, every portion of the wound purified, the injured part restored to the abdominal cavity, and the external wound closed. *See* LEMBERT'S SUTURE.

All parts of the abdominal cavity into which extravasation might have occurred must be thoroughly purified with clean sponges dipped in a warm 1 per cent. carbolic solution. Thorough cleansing of the abdominal cavity and the intestine is an important part of the operation. If this can be perfectly accomplished the external wound can be closed without inserting a drain, but drainage is, as a rule, necessary.

The operation of suturing a piece of wounded intestine and, still more, resecting it, lasts a long time. The patient must be kept warm, the intestine protected by compresses wrung out of warm 3 per cent. carbolic solution, frequently changed. Afterwards ether injections may be given to prevent shock, and opium. Nothing should be taken by the mouth for the first few days except a little milk and ice. Nutrient enemata must be administered. After the fifth day milk, soup, and a little bread may be taken, and in a week or ten days ordinary simple food.

The most dangerous period is from the third to the fifth day, when the sutures cut their way out. Union takes place by fibrinous exudation and adhesion of the adjacent omentum and loops of intestine. It is only as a rare exception that such a measure as this can be carried out successfully or even attempted in cases of gunshot injury; but we are justified in making the attempt rather than permit the inevitably fatal result to take place.

Artificial anus sometimes persists after recovery from a gunshot wound of the intestine. It is a painful infirmity, and, if high up in the intestine, interferes very seriously with the patient's nutrition. A fistula which is not associated with much loss of substance of bowel, such as a pistol-bullet may produce, can spontaneously close, or with the aid of a plastic operation. Where there has been loss of substance the éperon of Dupuytren will form. The fistula may sometimes be cured by dividing it; otherwise the abdomen must be opened, the ends of the intestine detached from the abdominal wall, resected and sutured together as before described, and the external wound then closed. In civil practice these operations have been followed by a large measure of success. *See* ARTIFICIAL ANUS.

Several times during the war of 1870 a fistulous communication between the bladder and rectum was observed to follow a wound traversing the pelvis. A spontaneous cure sometimes occurred. In others the fistula persisted. In some of these the rectum has been incised towards the coccyx to afford room for more ready access to the fistula. The margins of the fistula may be then excised and deep silver-wire sutures inserted, superficial silk ones being introduced as well. The result is uncertain. In cases of failure an opening in the descending colon will afford much relief. When the bladder and small intestine communicate abdominal section is the only means of dealing with the fistula. The adhesions may then be separated and the openings closed by suture. A portion of intestine may have to be excised as well. An operation of this kind is of course very severe, difficult, and dangerous to life, and the cases in which it is likely to be undertaken must be very few.

GUNSHOT WOUNDS OF THE GENITAL ORGANS are comparatively rare. The body of the penis may be traversed by a bullet without injury to the urethra, or the urethra alone may be divided by the ball. In most cases there is also a wound of the thigh, scrotum, testicle, or perineum. In one case the bullet lodged in the corpus cavernosum, and when this body is wounded there is always severe bleeding. After recovery the cicatrix will interfere with erection. When the urethra is wounded urination will be difficult, or there may be complete retention; the tube may be partially or completely divided. Infiltration of urine generally takes place. The mortality is considerable—about 20 per cent.—and when recovery takes place urinary fistula and traumatic stricture are the inevitable results. When the urethra is torn through by a bullet, a catheter should be introduced if there be retention; if this be impracticable, external urethrotomy may have to be performed. It is often very difficult to find the proximal end of the urethra, which will be retracted or buried in the tissues. A catheter should never be left for a long time in the bladder, as it excites cystitis. Urinary fistulæ are difficult to cure. Various forms of plastic operation have been devised for the purpose. Scrotal wounds are common, and the testicle is at the same time more or less damaged; inflammation is set up in it, and it may either atrophy or its secreting structure become destroyed as a result of suppurative inflammation. In about half the cases both testicles are injured. There is usually considerable shock and severe pain experienced at the time. Neuralgic pain, often severe enough to demand castration, is not an infrequent consequence. A gunshot injury of the testicle should be treated as conservatively as possible. Scrotal fistulæ usually heal after scraping with a sharp spoon and dusting the surface with iodoform.

As a matter of fact, gunshot injuries of Arteries and Veins comparatively rarely come under treatment. This infrequency of wounds of the arteries by gunshot injury is more apparent than real, as, almost without exception, a man wounded through one of the main arteries dies where and when he falls, before aid can reach him. Stromeyer estimated the number of vessel wounds at 3 per cent. of the total of those wounded. When the artery is fixed, especially if it be enclosed in a bony canal like the vertebral or middle meningeal arteries, it is more liable to injury.

The bullet may directly injure the vessel, cause a fragment of bone to be driven against or into it, or pass partially round the vessel, contusing and separating it from its vascular connections, especially in the thigh. This is liable to be followed by sloughing or ulceration. The fact of gunshot contusion is rather inferred from the clinical history of the cases and the frequency of secondary hæmorrhage than proved by post-mortem demonstration. The artery may be lacerated, and completely or partially divided by the bullet. The bullet or a fragment of bone may lodge in the vessel-wall itself, causing a temporary obliteration which is rarely definitive, but mostly followed by secondary hæmorrhage. When the projectile lodges in the vessel-wall it soon becomes displaced by its weight. This lodgment is not infrequent. It is a common experience for fearful hæmorrhage to follow attempts at extracting either a bullet or a fragment of bone, and in some cases it may be due to this circumstance.

In large vessels the bullet may traverse the vessel, and make an entrance and exit wound. The writer amputated a thigh for gangrene in Servia, in which a subsequent examination showed two well-defined circular apertures of this kind in the popliteal artery caused by the bullet traversing it. The same thing has occurred in the aorta, and the iliac and carotid arteries. In other cases the ball cuts out a portion from the side of the vessel. When a limb is carried away by artillery fire there is often no bleeding, the elasticity of the main vessels allows of their being drawn out of their sheath before giving way, and, in a manner analogous to that of torsion, their lumen will be closed by retraction of the inner and middle coats.

When a large vessel is wounded the hæmorrhage is usually directly fatal. If otherwise, spontaneous arrest may occur until the man is carried to the nearest field hospital. The provisional clot arrests the bleeding for a time. Severe bleeding is still less frequently observed from wounds of large veins. In gunshot wounds of the head the bleeding may be copious from one of the sinuses, and may be recognised by a rhythmical increase during expiration. In a few cases there has been an entire absence of bleeding at first, and after an interval a sudden hæmorrhage may take place. Probably the artery has been injured by a ball or fragment; the foreign body remains lodged and occludes the wound, and on its removal or separation by inflammatory processes, usually ten or twelve days after the injury, sudden bleeding occurs.

Secondary hæmorrhage frequently occurs about two or three weeks after the injury from separation of a contused portion of the artery, or an unhealthy suppuration in the wound causing ulceration of the arterial tunics. The increased action of the heart, due to fever, may dislodge the clot and give rise to hæmorrhage. Generally during the first week, or up to the tenth day, rough manipulation, difficult transport, cough, vomiting, straining at stool, may excite it. The same principles which are adopted for hæmorrhage occurring in civil practice are applicable to its occurrence after gunshot wound. In all cases of primary bleeding the wound in the vessel should be, if possible, exposed, and a ligature applied above and below the injured point. Where the position of the injury is such as to render it anatomically inaccessible, a ligature may be applied to the main trunk on the proximal side. *See* ARTERIES, Wounds of.

In secondary hæmorrhage the same rules apply; but the difficulty of finding and securing the bleeding points in the wound is greater. Nevertheless the attempt should always be made; where it fails we may tie the main artery in its continuity, but the results are most unsatisfactory. The circumstances which conduce to the frequent occurrence of secondary hæmorrhage continue, and it is apt to recur either in the original wound, or from that made in order to secure the artery about the time the ligature separates.

QUESTION OF OPERATION FOR GUNSHOT INJURY.—The majority of gunshot injuries in time of war take place in the extremities —three occurring in the upper to four in the lower. The gravity of the injury depends as a rule on the extent to which the bone is fractured or a joint involved. It is for cases such as these that the majority of amputations, either in continuity or through an articulation, require to be performed. It may be laid down as a rule that primary amputation of part or whole of the upper extremity is seldom if ever required for bullet wound, however extensively the bone may be fractured; even in cases where the brachial artery has been divided an attempt should be made to save the limb, although amputation may become necessary at a later period.

The injuries of the upper limb which may demand amputation are extensive lacerations of soft parts produced by shell-fragments. In civil practice it may be necessary from a charge of shot fired into the axilla, destroying the axillary vessels and nerves, or the structures in front of the elbow. In the case of injury to the joints, conservative treatment should always be first adopted. Primary excisions are more dangerous to life than those performed at a later period, and the results, as regards the function of the limb, much less satisfactory.

In the lower limb, other things being alike, the effects of gunshot injury are more severe than in the upper, and amputation more frequently called for. In the lower extremity, flesh wounds, except those produced by extensive shell-injury, or complicated by injury to the principal nerves or vessels, seldom demand amputation. Gunshot fracture of the femur is the most frequent form of fracture of the long bones, and the most dangerous to life, the mortality being, in wound of the upper third, 72 per cent.; middle third, 60 per cent.; lower third, 53 per cent. Formerly amputation was generally performed for this injury; but recent experience proves that expectant treatment affords the best results, especially when the wounded can be properly treated from the time of injury, and have not to be transported. Stromeyer has done much to establish this principle of treatment. After the battle of Langensalza, out of 38 cases of fracture of the femur, 28 recovered under conservative treatment; and the writer had an opportunity of seeing the cases under Stromeyer's care in the field hospital at Floing, close to Sedan, where 24 cases of fracture of the femur recovered out of 34—a per-centage of 70·6 per cent.

Fractures of the leg are not nearly such dangerous injuries as those of the thigh. When produced by shell-fragments the damage is often so extensive as to demand amputation, especially when in the neighbourhood of the knee. Bullet wounds often cause very extensive fissuring, which may involve either the knee or the ankle joints. In these, although primary amputation may not be deemed necessary, subsequent inflammatory changes may render it imperative at a later period; otherwise, expectant treatment yields, in general, better results than operative interference.

The mortality after amputation of the leg varies in an extreme degree in different campaigns. During the American war it was only 26·02 per cent.; in the English army in the Crimea 34·52 per cent., whilst among the French it reached 71·95 per cent.; among the Germans in the war of 1870–71 it was about 36 per cent., whilst among the French troops during the same campaign the deaths after amputation of the leg amounted to the frightful mortality of 82·34 per cent.

In injuries of the foot and ankle, conservative treatment is in the first instance to be adopted. If this fail, secondary excision of the ankle-joint may be performed—an operation which has attained, in Langenbeck's hands, the most brilliant results—or such portions of the foot only amputated as it may be impossible to preserve. The death-rate after amputation at the ankle-joint is not great. During the American war it amounted to 13 per cent. Gunshot injuries to the tarsus generally are not very dangerous, and often heal, as Stromeyer has pointed out, with unexpected facility after the extraction of the bullet. When, as the result of inflammatory processes, caries or necrosis of these bones is set up, the methods of treatment adopted will be identical with those employed for similar conditions occurring in civil practice.

The difference of opinion amongst the older surgeons as to the comparative merits of primary and secondary amputation has long since been settled in favour of the former.

As regards the place of amputation, only what is irretrievably damaged should be removed. The maxim 'Jeder Zoll, dem Leben naher!' should be borne in mind. Every inch removed adds to the patient's risk. It is, however, sometimes difficult to determine the degree of injury inflicted on the soft parts. In cases of severe contusion and laceration, the damage to the skin and muscles often extends further than is apparent, and after operation, gangrene of the flaps, necrosis of fascia, and suppuration in the intermuscular cellular tissue follow. Where the amputation is performed during the secondary period it is easy to determine the place of operation, and it is by no means necessary to discard the infiltrated and inflamed skin, or tissues through which fistulæ pass; they may often be used for covering the stump, all granulation tissue being previously scraped away, the surface disinfected, and good drainage provided for. At one time a limb was often amputated at a higher point than the injury rendered necessary in order the more readily to accommodate the stump to the instrument-maker's apparatus, a proceeding now properly abandoned. The instrument-maker should accommodate his apparatus to the stump just as much as a shoemaker fits his boot to the last.

This is not the proper opportunity to discuss the various methods of operation. Suffice it to remark that the flaps to cover the bone must be made much more ample than is needful in cases of disease. This is especially true of muscular flaps. The muscles are large and thick, and the skin retracts to a greater degree than in a limb the subject of disease; the operator is therefore not unlikely to underestimate the amount of covering required. As a rule, only a limited amount of muscle should be preserved in the flaps. In all cases where it is practicable, a circular or flap-shaped piece of periosteum should be detached from the bone to a sufficient extent to allow the cut end to be covered by it. The subsequent risks are thus diminished, the periosteum protects the medullary cavity, there is less chance of necrosis, and the stump subsequently is less sensitive and better able to sustain pressure. It is easy to separate the periosteum with an elevator, and it should be detached from the bone in such a manner as to retain its connection with the external soft parts. The more quietly and deliberately an operation is performed the better. Bleeding points should be secured as soon as possible with pressure-forceps. Too much pains, time, and attention cannot be bestowed on the task of thoroughly arresting the bleeding from every point. The occurrence of reactionary bleeding, necessitating as it does a change of dressing, diminishes considerably the chances of the patient's recovery. So far as they are practicable, strict antiseptic precautions should be adhered to throughout.

The rules laid down with regard to amputation are equally applicable to disarticulations. The operation is scarcely so favourable as amputation. It is more difficult to execute, and often involves a larger sacrifice of tissue, while artificial apparatus is more difficult to apply. For some of the joints the flaps are made of skin only, and in some, as at the knee, they are so long as to be extremely liable to gangrene; in others, as at the hip, muscle is usually included.

The mortality after amputation has very much diminished during recent wars; there are, however, no considerable statistics giving the results of operations performed with antiseptic precautions, and the tables of mortality hitherto recorded can only afford us the comparative rate of death after operations in different regions. Fischer has added together the results of the Crimean, Italian, American, Schleswig-Holstein, and Franco-German wars. He finds the mortality after amputation of the thigh is 82·6 per cent.; of the leg, 61·3; of the foot, 46·7; of the arm, 37·4; of the forearm, 21·2.

The comparative mortality of disarticulation arrived at in a similar manner is, after the disarticulation at the knee, 68 per cent.; at the shoulder, 62·8; at the elbow, 24·0; at the wrist, 42·2. Disarticulation at the hip-joint gives a mortality for primary operations of 91·6 per cent.; intermediate, 95·2; secondary, 76·6.

The antiseptic method of treatment will change all these figures. Schede gives tables of 321 cases of amputation treated antiseptically, in which only 14, or 4·4 per cent., died. 86 of these cases were amputations of the thigh, with 6 deaths, or 6·9 per cent. 69 amputations of the leg, with 1 death, 1·4 per cent. Amongst the 14 deaths, there were only 2 cases of pyæmia. Of 387 cases of amputation of equal importance, treated according to the old plan, 110, or 29·18 per cent., died, and there were 98 cases of pyæmia. Schede further calculates that, if the cases of pyæmia be omitted, the number and causes of death were almost identical in the two series.

The chief causes of death shortly after the operation are shock, hæmorrhage, and exhaustion; those occurring later are almost always from septic poisoning. It has been observed in recent wars, by the majority of surgeons, that pyæmia becomes much more frequent during the later periods of the war than at the beginning.

The operation of excision of joints is more generally applicable and followed by better results in the upper than in the lower limb. As regards the function of the limb afterwards, secondary resection is better for the function of the part than primary. This is especially true of the shoulder, elbow and ankle. The mortality is, however, higher. According to the returns in Circular VI., the results ascertained in these cases were as follows:—

	Deaths	Mortality
Of 210 primary resections . .	50	23·8 p.c.
Of 298 secondary ditto . . .	115	38·8 „

When the SHOULDER-JOINT is largely opened into, and the head of the bone or glenoid cavity fractured, excision may be performed, and the same rule holds good in the elbow and wrist. The best method of operation is by means of a straight incision in front of the shoulder-joint, and at the back of the elbow and wrist joints. The periosteal investment of the bone, together with the muscular attachments, should be scrupulously preserved. It materially diminishes the amount of bleeding at the time, and enhances the power of joint-movement afterwards.

Esmarch has published the results of 40 cases of excision of the ELBOW; 6 only died, while 32 recovered with a more or less useful arm. One of the two remaining cases was amputated; the other never healed.

In 285 cases of excision of the elbow recorded in the American reports, the mortality amounted to 21·67 per cent. According to Billroth, the mortality after excision of the shoulder is 35 per cent., whilst among the injuries of that joint treated conservatively the mortality was 52 per cent.

The after-treatment of cases of excision in the upper limb should be simple. Stromeyer's cushion is the best apparatus for shoulder and elbow excisions, and as free movement is the result sought for, passive motion should be resorted to as early as possible.

Gunshot injuries of the HIP-JOINT have been regarded as very hopeless cases. Great doubt must exist in many cases as to the exact extent of the injury; the parts are very inaccessible, the symptoms uncertain, and a precise diagnosis often impossible. Out of 385 cases observed during the American war in which gunshot fracture was believed to have involved the joint-surfaces, 304 were treated expectantly, in 55 excision of the hip-joint was performed, and in 27 the limb was disarticulated. In the 304 cases the mortality was 81·9 per cent. Of 33 cases involving the acetabulum and head of the femur, only one recovered. The other cases of recovery were fractures in the neighbourhood of the joint, in a few of which it was undoubtedly involved.

Langenbeck has recorded 25 cases of injury of the hip followed by recovery during the war of 1870–71. It would be for the interest of surgical science that the precise extent of the injury to the joint in these cases should be ascertained by post-mortem examination.

During the American war the mortality after excision of the hip-joint was 90·6 per cent. In a total of 171 cases of excision collected from various sources, the death rate was 86·5, the mortality following the operation being somewhat less during later wars. Both after excision and amputation the mortality is greatest among those cases operated on during the intermediate period. It is least during the secondary period, when it closely approaches that for similar operations performed for disease in adults of the same age. Nevertheless, the disastrous results following gunshot fracture involving the hip-joint will prompt the surgeon to perform primary excision, rather than to expose his patient to the enormous risks of the inflammatory period; the fact that 23 survived out of 171 cases of excision, 1 being amputated and 22 possessing a more or less useful limb, is an encouraging result in a very hopeless class of cases.

In 250 cases of amputation at the hip-joint for gunshot injury, collected from different sources, 27 recovered, the mortality being nearly 90·0 per cent.

Of 27 primary amputations, 3 recovered. Of 23 intermediate amputations, all died. Of 9 secondary amputations, 2 recovered. The operation had therefore better be performed at once, unless it can be more safely delayed until the secondary period.

Secondary excision is demanded in cases of caries or necrosis, or secondary implication of the joint-surfaces.

Disarticulation at the hip-joint should be performed when the thigh is torn off; the upper extremity of the femur comminuted, with great laceration of the soft parts too high for amputation in continuity; for fractures of head, neck, or trochanters, complicated with wounds of the femoral vessels; for fracture involving the hip-joint, complicated with compound fracture lower down, or wound of the knee or ankle joints.

Knee-joint.—During the American war the opinion was generally in favour of immediate amputation for gunshot injury of the knee, and with few exceptions this also was the opinion of all former writers; in about one-fourth of the cases expectant treatment was adopted, with an attendant mortality of 60·6 per cent. The cases reserved for expectant treatment were the most favourable ones, and in 117 of the cases which recovered the patella only was fractured, and the synovial cavity not opened in the first instance. The result, nevertheless, contrasts unfavourably with the mortality after amputation of the thigh for gunshot fracture of the knee, which was only 51·1 per cent.

In a certain number of the cases the capsule only was injured, or only trifling damages inflicted upon the bone. In these the mortality was only 27 per cent., and such cases should when diagnosed be treated conservatively. Bergmann reports 21 cases without bony lesion during the Russo-Turkish war; 18 recovered, in 3 the result was unknown, and in 31 cases involving the bone 20 recovered and only 1 died. Langenbeck believes recovery to be much more common than is generally supposed in gunshot fractures of the knee-joint.

Primary excision of the knee is an operation which is scarcely justifiable in military practice, the mortality being 86·6, far in excess of amputation of the thigh, and the experience of later wars shows a similar excessive mortality. With our present knowledge we must pronounce an emphatic opinion against it. Amputation through the knee-joint itself is a little more unfavourable as regards mortality than amputation of the thigh. In 10 per cent. of the cases, re-amputation was found to be necessary. The stump, however, after recovery is a very good one.

Ankle-joint. — During the American war the general opinion seems to have been in favour of amputation for gunshot fracture involving the ankle-joint. In 159 cases of amputation of the ankle-joint itself the results were ascertained, the mortality being 25·1 per cent., or 7·8 less than the death rate after amputation of the leg. These operations include Syme's and Pirogoff's amputations, with their modifications.

Excision of the ankle seems to be rather more dangerous than amputation; the operation was seldom complete. The primary operation was the more favourable as regards life. Langenbeck is in favour of secondary excision on account of the more complete restoration of the portions of bone removed. The mortality after excision varies in different estimates from 29 to 33 per cent. Among cases treated expectantly, the mortality appears to have been 20 per cent. Where amputation is required it will generally have to be performed in the leg. The mortality after primary amputation is 5·3 per cent.

It is hardly necessary to go into details with regard to partial amputations of the foot. Individual bones may often require to be excised in addition to the performance of the more recognised operations.

William MacCormac.

GUSTATORY NERVE, Division of; Stretching of.—Division of the gustatory nerve for the relief of pain, caused by cancer of the tongue, was practised by Hilton and, subsequently, by Charles H. Moore. By Moore's operation—in most cases preferable—the nerve is cut a little in front of the point at which it emerges from between the ramus of the lower jaw and the internal pterygoid muscle, to cross obliquely to the side of the tongue. At this point it lies near and just below a ridge, which can be felt by the fore-finger, on the inner aspect of the lower jaw.

The point of a curved bistoury is introduced well through the mucous membrane of the floor of the mouth, at about the level of the last molar tooth, internal to the course of the nerve, and then made to cut out to the lower jaw and upwards, along its inner surface, in a direction corresponding with a line from the angle to the last molar tooth.

The relief may be considerable, at all events until the ends of the nerve have again united; but, unfortunately, the cases in which this operation is most likely to be required are those in which, from infiltration by cancer, the tongue is so fixed, and the landmarks are so obscured, that it becomes difficult to ensure division of the nerve excepting by incisions, which are by no means free from trouble in respect of hæmorrhage. Chloroform, also, may be necessary, and, in that case, the guide as to the division of the nerve, given by the patient's sensations, will be lost. On these accounts the operation is not now very frequently performed. In many cases, too, relief can be given in other ways. See *Palliative Treatment* under TONGUE, Diseases of the.

The gustatory nerve has been divided for the relief of obstinate neuralgia. Its division, in such a case, presents no difficulty. The nerve has also been *stretched* for the relief of the same complaint. Clement Lucas observed, in a case under his care, that on pulling the tongue strongly forward and to the opposite side, the nerve stood out as a cord beneath the mucous membrane, and could be readily fixed by passing a small, sharp hook around it. On dividing the mucous membrane, the nerve was then easily caught up by an aneurism needle. The same operation may be performed when it is desired to excise a portion of the nerve; or the latter may be dissected out at about the level of the last molar, through a vertical incision extending through the mucous membrane and margin of the sublingual gland (Hilton's method).

W. MORRANT BAKER.

H

HÆMATOCELE. — Any effusion of blood into the tunica vaginalis, testicle, or spermatic cord is called a hæmatocele. We must speak separately therefore of (A) *Hæmatocele of the Tunica Vaginalis*; (B) *Hæmatocele of the Spermatic Cord*; and (C) *Hæmatocele of the Testicle.*

(A) HÆMATOCELE OF THE TUNICA VAGINALIS.—1. *Causes.*—These may be classified as predisposing and exciting. The predisposing causes are, atheroma of vessels, leading to their brittleness and loss of due elasticity, by which they are rendered liable to rupture from sudden increase of internal pressure; chronic inflammation of the tunica vaginalis with the formation of vascular granulation-tissue on the inner surface of the serous sac, and very delicate vessels easily ruptured; and hydrocele. The second of these causes is laid stress upon by Gosselin; but other authorities consider the appearances on which he relies for evidence in support of his view, as really secondary to the effusion of blood. Hydrocele is of extreme importance, as predisposing to hæmatocele; for not only does it very commonly necessitate an operation for its relief, during which some vessel may be punctured, but the distension of the tunica vaginalis renders the scrotum far more liable to contusions than it is in its normal condition. Owing to the testicle being immovable in the scrotum, all violence applied to this part acts upon the testicle, which is frequently ruptured by squeezes and blows that would be harmless in the normal state. The exciting causes of hæmatocele are strains rupturing vessels into the tunica vaginalis, blows and punctures. When a hydrocele is tapped, the mere removal of the pressure to which the vessels of the serous membrane have become habituated may lead them to rupture; or the lancet or trocar may wound a parietal vessel, or be thrust into the cord or testis. This is more liable to happen when a lancet is used than with a trocar, and this fact is a sufficient reason for preferring a trocar to a lancet in cases where the tunica vaginalis requires puncture. Strains and blows of moderate severity are causes of hæmatocele probably only when the natural resistance of the vessels is diminished by previous disease.

2. *Pathology.* — The tunica vaginalis may contain a mixture of serous fluid and blood in various proportions, in which coagula of blood are sometimes found floating; at other times the blood is altered and becomes converted into a dark fluid of syrupy consistence, resembling treacle in appearance, or, becoming still thicker, it looks more

like coffee-grounds, and contains cholesterine. When the sac contains pure blood, this may coagulate into a spongy mass, which may present quite a honeycombed appearance, being riddled with spaces containing serum. In other cases the fibrin separates from the blood in dense layers, like those usually found lining the sac of an aneurism, and a certain amount of dark blood-clot may be found in places between the concentric laminæ of fibrin, or filling up a central cavity. The tunica vaginalis itself is thickened by a deposit of vascular 'false membrane' on its inner surface; this is generally considered to be secondary to the effusion of blood, but Gosselin argues that it is really primary, and that the hæmatocele is due to the rupture of delicate vessels in this membrane. The testicle is generally found in the lower and posterior part of the sac; but in cases of inversion of this organ, it will be found in front. It may be unaltered in outline and structure, but usually it is flattened out by the pressure of the effusion, and in cases of long-standing hæmatocele the testicle may be greatly wasted. Occasionally the occurrence of hæmatocele is followed by inflammation and suppuration of the scrotal coverings, and the sac of the tunica vaginalis is then found to contain a mixture of pus, fibrinous coagula, and blood-clot. In very chronic cases, the sac may become calcified.

3. *Symptoms and Diagnosis.*—The sign of most constancy and value in the diagnosis is the rapid development of an opaque scrotal tumour after a strain or local injury, or the sudden enlargement of a hydrocele with loss of its former translucency. The tumour is limited to the scrotum, is ovoid in shape, sometimes becoming globular, smooth in outline, always opaque throughout, and often fluctuating; but this varies greatly in different cases or in the same case at different times, for when the blood coagulates, the tumour, like other solid tumours, is devoid of fluctuation. There is at the time of its early formation an absence of signs of acute inflammation, but these may develop later on; the skin may quickly become mottled or deeply stained with blood. If the finger be pressed into the tumour at different places, 'testicular sensation' may be excited at one particular part of the tumour, and indicate the position of the testicle. The cord above the tumour is not enlarged, and there is no swelling of the iliac or lumbar glands. It is usually stated that a hæmatocele is a heavy tumour; but it is very doubtful if this is of any value for diagnosis, and if, indeed, it is possible to detect the difference in weight of hæmatocele, hydrocele, and sarcocele. If a rapid effusion of blood occur, the patient may experience symptoms of syncope at the time. The tumour may remain stationary as a fluctuating swelling; or it may solidify and contract; or the parts may become inflamed, the swelling increasing, the skin becoming hot, bright red, and tender, and at length an abscess points and bursts, discharging pus mixed with 'coffee-grounds' material, or masses of laminated fibrin. The diagnosis largely rests upon the history of the first formation of the tumour—its suddenness or marked rapidity without signs of inflammation, and its connection with strain, a blow, or the tapping of a hydrocele. In some old cases of hæmatocele it is impossible to make a certain diagnosis from tumour of the testicle without exploratory puncture (where the tumour is fluid), or incision (where the tumour is solid); but the absence of persistent growth, enlargement of the cord, and glandular implication, and the detection of the testicle at one particular part of the swelling, are the signs on which reliance is to be placed. An exploratory puncture may evacuate treacly fluid or 'coffee-grounds' material, and lead to the partial or total collapse of the swelling; exploratory incision, where the tumour is solid, will show thick masses of laminated fibrin or spongy blood-clot. *See* TESTIS, Diseases of the.

4. *Treatment.*—If seen immediately, the patient should be put to bed, and the scrotum be raised on a pillow placed between the thighs, and a light bag of crushed ice and salt applied. The bowels should be freely opened with a dose of calomel, followed by a saline draught; the diet should be light and unstimulating, and at the same time the patient should lie as still and quiet as possible. This may succeed in leading to the absorption of the blood. Should absorption not occur, and the blood continue fluid, the tumour should be tapped in the same way as a vaginal hydrocele, care being taken not to injure the testicle, and if after the blood is withdrawn much thickening remain behind, the part should be firmly strapped—this will accelerate the absorption of the fibrin and blood-clot. If the tumour be wholly or largely solid, a free incision should be made into it. This should be done carefully and gradually, as it may be impossible in these cases to localise precisely the testicle, and the surgeon should therefore cut slowly down, examining each

section before deepening it; the softer central parts may be easily evacuated, and then the firmer outer layers should be stripped off the tunica vaginalis, and the wound plugged and allowed to granulate up from the bottom; or if the surgeon prefer it, he may place a drainage-tube in the cavity, and stitch up his skin-incision. Where the tumour is of very long standing, and the fibrinous masses are so adherent to the thickened sac that they cannot be detached from it, the whole mass—testicle and all—should be excised. Where, too, the surgeon is so unfortunate as to inflict an extensive wound upon the testicle, castration should be performed. When inflammation occurs, the patient should be put to bed and the scrotum be treated with hot belladonna fomentations; or equal parts of extract of belladonna and glycerine may be smeared thickly over the part, and plain hot fomentations applied over it. When suppuration is suspected or has evidently occurred, a free incision should be made into the tumour, all the pus and clots turned out, and the cavity allowed to granulate up from the bottom.

(B) HÆMATOCELE OF THE SPERMATIC CORD.—1. *Causes.*—This may result from direct injury—blows and the like—or from strain, and it may be predisposed to by the presence of an encysted hydrocele of the cord.

2. *Pathology.*—The blood may infiltrate the cellular tissue of the cord and its coverings, or it may be effused into the sac of a hydrocele, or, being small in quantity, may become circumscribed in the cord. In the first case the tumour may attain an enormous size, and is known as a diffused hæmatocele of the cord; in the two latter instances the tumour is small, and is known as encysted hæmatocele of the cord.

3. *Signs and Diagnosis.*—Hæmatocele of the cord is a very rare affection. When diffused it may attain an enormous size, forming an elongated tumour, which may overlap the thigh for many inches; the tumour is boggy to the touch, dull on percussion, and the skin over it is freely movable. When encysted, the tumour is much smaller, tense, globular or ovoid in shape, opaque, with more or less distinct fluctuation, and fixed to the cord. Such a tumour may have been preceded by a smaller, translucent tumour. In either case the tumour will have followed more or less immediately upon a strain or blow on the part.

4. *Treatment.*—A diffused hæmatocele, when recent, should be treated by rest, and the local application of cold, aided by a free purge and low diet. When this proves ineffectual, or the case comes for treatment at a later stage, absorption of the blood may be aided by counter-irritation by means of fly-blisters to the part, or painting it with tincture of iodine night and morning. Should these measures fail after a fair trial, and the tumour be of distinct inconvenience to the patient, the surgeon should make a free incision into it for its whole length, let any blood that will, escape, and then plug the wound and allow it to granulate up. Encysted hydrocele in the acute stage may be treated like the diffused; if absorption do not occur and the blood remain fluid, it may be tapped with a trocar; and should this fail to effect a cure or the tumour be found to be solid, it should be freely incised and the entire sac dissected carefully out from the cord; or the surgeon may content himself with turning out all the contents of the cyst and plugging the wound.

(C) HÆMATOCELE OF THE TESTICLE consists of two distinct affections: hæmorrhage into an encysted hydrocele—encysted hæmatocele of the testicle; and hæmorrhage into the substance of the gland itself—parenchymatous hæmatocele. Both are rare, the latter especially.

Encysted Hæmatocele of the Testicle.—1. *Causes.*—This condition only occurs secondarily to an encysted hydrocele of the testicle, the effusion of blood being due to injury, such as a blow or squeeze rupturing a vessel in the cyst-wall. Tapping such a cyst may be followed by hæmorrhage, as in the case of vaginal hydrocele.

2. *Pathology.*—The pathology is exactly similar to that of vaginal hæmatocele. *See* also *Encysted Hydrocele*, under HYDROCELE.

3. *Symptoms and Diagnosis.*—In its position and general characters the tumour resembles an encysted hydrocele, being tense, globular, and adherent to the testicle or epididymis. It differs, however, in being opaque; the fluctuation in it is less distinct, and there may be marked tenderness. The diagnosis is further aided by the fact that the swelling, which is of a chronic nature, has rapidly or suddenly increased after a squeeze or some similar injury to the parts, or that the swelling has rapidly re-formed after tapping a hydrocele.

4. *Treatment.*—In the acute stage, rest and cold applications are indicated. Later on the cyst may be tapped and injected with iodine, or freely incised, evacuated, and dressed from the bottom; where the blood has coagulated but is not absorbed, the latter is the only appropriate treatment.

Parenchymatous hæmatocele is an effusion of blood inside the tunica albuginea. It is always the direct result of a severe injury to the testicle, and is a cause of acute pain. The blood is poured out from the layer of fine vessels beneath the tunica albuginea called the tunica vasculosa. This condition is probably in all cases associated with vaginal hæmatocele, which obscures the enlargement of the testicle. The blood may be absorbed, or may remain as a firm or friable mass, or may lead to the softening of the tunica albuginea and its ultimate rupture. The tubular structure of the testicle is compressed, and the organ probably never regains its former size or functional activity.

1. *Symptoms and Diagnosis.*—When, combined with the signs of vaginal hæmatocele, there is severe and persistent pain in the testicle, extending up along the groin to the loin, and the testicle is found very sensitive to pressure, a parenchymatous hæmatocele may be suspected. When, on tapping, or otherwise evacuating the vaginal sac, the testicle is found to be enlarged and tender, this diagnosis becomes assured. If the scrotum is freely incised, the wound does not heal and the enlarged testicle presents, and a dark or livid protrusion from its surface may be recognised; in some cases fluctuation may be detected in this projection.

2. *Treatment.*—When there is reason to suspect this condition, great care should be taken to ensure absorption of the effused blood by rest, cold applications, purgatives, and suitable diet. Should the vaginal hæmatocele be absorbed or yield to simple tapping, the enlarged testicle should be carefully strapped. If the scrotum is incised, and the position of the parenchymatous hæmatocele can be verified by fluctuation, livid colour, or obvious protrusion, a free incision should be made into it and the blood be turned out. Great care should be taken to render such a wound aseptic.

A. Pearce Gould.

HÆMATOMA. *See* Bruises; Head-injuries; Scalp, Injuries and Diseases.

HÆMATOMA AURIS. *See* Ear, External, Diseases of the.

HÆMATURIA.—*Definition.*—Blood derived from any part of the urinary system—be it from its secreting, conducting, or collecting divisions—and passed pure, or mixed with urine, constitutes the symptom known as hæmaturia. It will be observed that the above definition is so framed as to include urethral hæmorrhage, which is always admitted for convenience' sake under this heading, though not strictly speaking hæmaturia. Hæmaturia is a symptom which may occur, not only in the course of most of the diseases and injuries to which the tract is liable, but also in some morbid conditions of the blood, e.g. purpura, scurvy, smallpox, typhoid, &c., and in some cases of metallic poisoning, e.g. mercury, lead, arsenic. The colour of the urine may vary through many shades, from a cherry red (1 in 800, Ralfe), to a maroon colour, or from a smoky or beef-tea aspect to a porter-black, according to the proportionate admixture of the two fluids, and the extent to which the methæmoglobin, or the oxyhæmoglobin has been altered by the action of the urine.

Fallacies.—These colours may be simulated by the effect upon the urine of particular drugs or certain articles of diet—e.g. senna and rhubarb give a reddish tinge to alkaline urine; carbolic and salicylic acid impart a brownish colour, while beetroot, sorrel, and prickly pear produce a blood-red aspect. Again the urine in certain pathological conditions—e.g. in severe jaundice, melanosis, and splenic fever—assumes a deep brown colour, while in the female the mere admixture of menstrual discharge may deceive by its colour a careless or superficial observer.

Tests.—The following are reliable:—

Microscopical.—Blood-corpuscles are seen more or less altered by the action of the urine. *Fallacies.*—In hæmatinuria they are absent, and in very alkaline urines they are only detected with difficulty.

Spectroscopical.—Blood, even in minute quantities, will give two absorption-bands between the Frauenhofer lines D and E in the yellow and green of the spectrum.

Chemical (*a*). The formation of Teichmann's crystals on heating traces of blood with glacial acetic acid and a crystal of salt; (*b*) invariable presence of albumen; (*c*) a particoloured fluid being left after the settling of the brick-red precipitate produced by boiling the urine with caustic soda.

It is imperative to ascertain the site and cause of the hæmorrhage. We may divide these sources into three groups: (*a*) renal, including the pelvis of kidney and ureter; (*b*) vesical, including the prostate; (*c*) urethral.

Differential diagnosis of source of blood.—1. *Colour*, in bright florid urine it is probably of vesical, in dark or smoky urine of renal origin. *Fallacies.*—If from any cause the blood has been retained in the bladder, it will assume a dark colour in proportion to the action of the urine upon it; indeed, sometimes, if long pent up in that viscus, it may be evacuated like tar or molasses. Again, if the blood issues in large quantities from the pelvis, rapidly traverses the ureter, suddenly distends and thereby stimulates the bladder, it will be expelled thence, bright, fluid, and unchanged.

2. *Reaction.*—Bloody urine, if acid, is generally of renal source; if alkaline, of vesical origin. *Fallacies.*—(*a*) ingestion of alkalies (inducing alkalinity of urine); (*b*) a profuse effusion of blood, or (*c*) an excessive production of pus, may mask, by their alkalinity, the natural acidity of the renal secretion. In these cases the hæmorrhage may be from the kidney, although the reaction would point to vesical mischief.

3. *Aspect of clots.*—By floating the coagula in water, they may so unravel as to afford us a clue to the seat of the hæmorrhage. The softer, the brighter, the plumper the clot, the fresher is the effusion and the nearer is the site of the hæmorrhage to the outlet. The more decolorised and eroded the clot, the longer has been its retention in the tract. Slender cylindrical worm-like clots are generally moulds of the ureter; thus they localise bleeding in or above that canal. Large, irregular, shapeless, edge-eroded clots are usually of vesical origin. Leech-like, ovoid clots are from the posterior portion of the urethra, and long bougie-like coagula are from its anterior part. *Fallacy.*—The blood may have been of renal origin, or have regurgitated from the urethra and become moulded in the bladder; thus renal or urethral hæmorrhage may simulate vesical.

4. *Aspect of urine on micturition.*—If the blood issues independently of micturition, or if it is evacuated first and then followed by clear urine, the source is urethral. If the urine is at first clear, or only tinged with blood, becoming darker, or even like pure blood, at the close of the act, it is vesical. If uniformly mixed, it is, most likely, renal. *Fallacy.*—Blood issuing from the bladder-wall, or regurgitating from the urethra, may become so intimately mixed with the urine there collected—especially if the quantity of the blood be small—as markedly to simulate renal hæmaturia.

5. *Microscopical.*— Blood-casts are conclusive proofs that the secreting substance of the kidney is involved. Triple-phosphate crystals in freshly passed urine are tokens of vesical mischief.

6. *Instrumental.*—Wash out the bladder very gently, three or four times, and notice the colour of the washings; now insert a gum-elastic or flexible catheter just within the thus emptied bladder; the urine will trickle directly from the ureters into the eye of the instrument (Sir H. Thompson). Compare carefully the samples thus obtained.

7. *Symptoms.*—Certain symptoms referable to source are usually obtainable. Heat, tenderness, aching or pain in one or both loins, numbness of leg, retraction of testicle (in stone, not carcinoma) would point to renal origin; supra-pubic, perineal, or penile pain, dragging weight in perineum, dysuria would indicate a vesical source, or at least implication of that viscus.

Pathology and Etiology.—Any active or passive hyperæmia, any inflammation or ulceration, any vascular rupture in any section of the urinary tract, may give rise to hæmaturia. *Renal:* active hyperæmia (cantharides or turpentine), passive hyperæmia (thrombus of renal or inferior caval veins), embolism, renal diseases, traumatism, stone, neoplasms, calculous or tubercular pyelitis, transit of ureter by a stone. *Vesical:* traumatism, inflammation, ulceration, or enlargement of prostate; sudden evacuation of a chronically distended bladder; stone or foreign body, neoplasms, cystitis, varix vesicæ, ulcerations (tubercular, diphtheritic), parasites, (Bilharzia hæmatobia). *Urethral:* traumatism, stricture, impacted stone, acute gonorrhœa, chancre, neoplasms.

Diagnosis of cause.—The history and age of the patient are to be considered, all subjective and objective phenomena carefully weighed, and thorough examination of the abdomen and urine undertaken; but space will only permit us to point out that abdominal palpation may reveal a renal tumour, supra-pubic and rectal examination may disclose an infiltration or growth of the bladder, maybe an enlargement, or a deposit or growth in the prostate. The sound may detect a stone, or, by a sense of resistance, a vesical growth. The catheter may withdraw in its eye a shred of growth or disintegrating villus. Again, the microscope may confirm our suspicions of malignancy, aroused by the passing of small semi-gelatinous masses; or it may give us a clue to the calculous diathesis or formation, by the aspect of the crystals found in the urine; or it may demonstrate the bacillus tuberculosus in the small whitish clumps passed in pyuria mixed with blood, when these are stained with Ehrlich's solution; or, lastly, it may reveal the ova of the Bilharzia.

The hæmorrhage may be profuse in

traumatism, stone, or neoplasms. It is generally slight in active or passive renal hyperæmia, in embolism, in inflammation or superficial ulceration of the tract. Dark, porter-like urine, passed without pain or any other symptom, is most probably renal. Hæmorrhage in vesical carcinoma is generally sudden, profuse, and irregular in its occurrence; in villous disease it is slight but persistent.

In non-malignant vesical growths the hæmorrhage occurs suddenly, and usually precedes the pain and dysuria. In malignant disease this is generally reversed.

Prognosis.—If the hæmorrhage occurs in the course of febrile disease, it is unfavourable; without reference to the cause it may be said to depend upon the suddenness of the onset, the amount lost, the capability of bearing that loss, and the age and sex of the patient. The dangers which may arise from the *clot* are (*a*) absolute retention, (*b*) pyelo-nephritis from its decomposition, and (*c*) the formation of a stone upon it as a nucleus, all of which are luckily rare.

Treatment.—Enforce, if possible, (1) absolute rest in the recumbent posture; (2) efficient application of cold. If renal, Leiter's tubes moulded to the loin; or, failing this, ice-bags or cold wet wraps to the same part. If vesical, Leiter's tubes or ice-bags adjusted to the supra-pubic and perineal regions. Ice in the rectum; ice-cold vesical and rectal injections. If urethral, pass a full-sized sound and gently apply a finger-bandage to the penis; apply ice-bag to the perineum.

Internal hæmostatics: Ext. ergotæ liq. fʒss.; Acid sclerotici (hypodermically), gr. $\frac{1}{4}$ to gr. j.; Liq. ferri perchlor. ♏x. to fʒss.; Liq. ferri pernitratis ♏x. to fʒss.; Acidi gallici gr. x.; Acidi tannici gr. x.; Infusi matico, f℥ij. Tr. Hamamelis Virgin. fʒss.; Plumbi acetat. gr. iij.; Ol. terebinth. ♏v. in passive hæmorrhages, administered cautiously.

Opium is of great value in every case, except it be in renal disease.

The following injections in vesical hæmaturia are of value: Alum gr. xx. to the pint; Nitrate of silver gr. j. to gr. iij. in f℥viij.; Liq. ferri perchlor. ♏xx. to ♏lx. in f℥viij.; Tr. Hamamelis Virgin. f℥j. ad f℥iv. Should the bladder become distended with coagula, it will be felt above the pubes as a hard round mass. Opium must be given freely to allay the dysuria, and the clot allowed to come away by itself.

If, however, absolute retention ensues, which is rare, or if enlarged prostate or atony of the bladder co-exist, a soft rubber catheter must be introduced, and a lithotrity evacuator adapted to it; thus the coagula can be carefully, slowly, and safely withdrawn.

E. HURRY FENWICK.

HÆMOPHILIA.—A hæmorrhagic diathèsis, which is usually inherited, and in nearly all cases manifests itself during the first few years of life. Painful swellings of the joints are frequently associated with the disorder.

Cause.—Hæmophilia seems to be more common among the inhabitants of northern countries, but probably occurs in all parts of the world. Heredity is the only undoubted etiological factor, though gout, scrofula, tuberculosis, frights received by the mother during pregnancy, and consanguinity of parents, have all had a certain influence ascribed to them.

The hereditary transmission of the disease is usually characterised by a peculiar and definite order. For whereas the male sex is specially prone to hæmophilia, the disease is handed down through the females. In a typical case the children of a bleeder remain free from the disease, but hæmophilia reappears in the daughter's sons; these, again, beget healthy children, and transmit the disorder through their daughters to their grandsons. The daughters of a bleeder may also pass on the hæmorrhagic tendency, through their own daughters, to the sons of the latter. In none of these cases, as a rule, are the females themselves bleeders. The healthy brothers of a bleeder appear not to transmit the disease to their descendants. In rare cases the children inherit the tendency directly from their father or mother. More rarely still the females in a bleeder family manifest a greater proclivity to hæmophilia than the males. Bleeders are extremely prolific, but the proportion of the members of a given family that manifest the disease varies considerably. In some instances, hæmophilia seems to arise *de novo*.

Pathology.—No constant morbid changes have yet been detected in any part of the body. The blood shows no alteration whatever, and coagulates naturally until repeated hæmorrhages beget a condition of hydræmia, similar to that produced by any profuse bleeding. Coagulation then becomes defective. Changes have been found in different parts of the vascular system, but with no constancy. It is probable, nevertheless, that there is some subtle change in the small vessels. In certain cases there seems to be a state of plethora. A more intimate knowledge of the chemistry of the blood may possibly enable us to detect some error in its composition. The pathology of hæmophilia is still obscure.

Symptoms and Diagnosis.—Bleeders present no characteristic appearance whatever. Profuse and repeated hæmorrhage is the only positive symptom of the disease. The bleedings may take place from some free surface or cavity of the body, or they may be interstitial. They may be divided into two varieties, spontaneous and traumatic, which are often combined in the same subject. The spontaneous bleedings usually arise from some mucous membrane, less frequently they occur beneath the skin. In the traumatic form, the blood may come from almost any part of the body. The traumatic type is almost confined to the male sex. Both sexes, however, are liable to the spontaneous form of hæmophilia, which commonly takes the shape of epistaxis, or profuse menstruation in women. In fully half the cases recorded, hæmophilia declared itself during the first year, and in seventy per cent. the bleedings began before the end of the second year. The disease rarely makes its appearance later than the tenth year, and in no instance has it developed after the age of twenty-two.

As a rule the child is born without suffering any loss of blood, and division of the umbilical cord rarely causes serious hæmorrhage. Separation of the stump of the cord has occasionally been followed by considerable bleeding. More often the child seems healthy for some weeks or months after birth, until it is suddenly attacked by profuse hæmorrhage. This frequently takes place at the period of the first dentition, when the child begins to crawl about and is liable to slight injuries. In most cases the first bleeding is traumatic, though a tendency to spontaneous hæmorrhages usually develops subsequently. A tendency to traumatic hæmorrhage is found in the most marked cases, but is often characterised by great fluctuations in intensity. At times, the slightest injury is sufficient to cause alarming loss of blood. Similar or even graver accidents may lead to comparatively trifling hæmorrhage on other occasions.

Analogous variations in the tendency to spontaneous bleedings are also observed. Some bleeders recover rapidly from the effects of severe hæmorrhage, while others become profoundly anæmic and succumb, at last, to repeated losses of blood. Most of the well-marked cases of hæmophilia terminate fatally after frequent hæmorrhages. In some cases the hæmorrhagic tendency gradually declines with advancing years, and in one or two instances has suddenly and completely disappeared. If the period of puberty be safely passed, there is a fair chance that the patient may outgrow the disease.

The attacks of bleeding are sometimes preceded by symptoms of congestion of a more or less definite nature. Generally they come on without any warning, often in the night. Except when a large artery is injured, the blood oozes continuously from the affected part, and probably comes from the capillaries. The mucous membrane of the nose is the most frequent source of the bleeding. Next in order comes the cavity of the mouth and the gastro-intestinal canal. Subcutaneous hæmorrhages are not infrequent, and usually appear as irregular ecchymoses; at times they give rise to large fluctuating blood-tumours. The blood, in such extravasations, has a tendency to remain fluid for a long time. The skin of the extremities is the part most frequently affected. The uro-genital and respiratory tracts are less often the seat of bleeding. Cerebral and meningeal hæmorrhages are very rare. Extraction of a tooth is one of the most dangerous and fatal of all injuries, as the bleeding in such cases sometimes resists all treatment. Friction of a jagged tooth against the cheek or tongue, and the slightest abrasion of the gums, such as that caused by a toothbrush, have produced alarming results. Division of the frænum linguæ, circumcision, and blood-letting are also fraught with great danger. It is remarkable that serious bleeding is hardly ever caused by vaccination.

The peculiar joint-affection of hæmophilia, long considered to be rheumatic, has now been proved in some cases to be due to hæmorrhage into the joint, and this would seem to be its usual cause. It is probable, however, that some of the swellings are purely inflammatory. The affection consists in painful effusion into the joint, combined, at times, with ecchymoses of the skin. Any of the larger joints may be attacked, but especially the knee. The swellings are very apt to recur, and may lead to permanent enlargement or destruction of the joint, or to anchylosis. As a rule the swelling occurs spontaneously, especially in cold, damp weather, and is only exceptionally the result of an injury. The joint-affection is almost confined to the severe traumatic form of hæmophilia, and is rarely seen except in the male sex. Pains in the limbs are very common, and are often due, probably, to small hæmorrhages into the muscles and other tissues of the part. The urine and other secretions appear to undergo no important alteration.

Diagnosis.—Hæmophilia in its traumatic form, or when it is both congenital and hereditary, can be mistaken for no other disease. Difficulties in diagnosis arise when a tendency to spontaneous bleedings appears in a member of a healthy family. If the diathesis show itself within the first two years of life, and especially in a male child, the disease is probably hæmophilia. The diagnosis is more doubtful in the case of a girl, or when the tendency appears at a later age.

A hæmorrhagic diathesis, in women who are not of a bleeder family, must not be taken for hæmophilia unless the hæmorrhages has begun during early childhood. In the case of umbilical hæmorrhage, the diagnosis would turn on the presence or absence of hereditary disposition.

Hæmophilia can scarcely be confounded with purpura or scurvy, which are transitory disorders, and are neither congenital nor inherited.

Treatment.—A bleeder must of course be protected as far as possible from all accidents, and should avoid excitement of any kind. A nutritious and digestible diet, without alcohol in any form, warm clothing, gentle exercise, and residence in a temperate climate are desirable. Vaccination should not be omitted. No woman in a bleeder family, whether she be a bleeder or not, and no man who is himself the subject of the disease, ought to marry. The treatment of the hæmorrhage is generally unsatisfactory. Complete rest in bed is to be insisted upon invariably. Although internal medication alone avails little, it seems well to combine the use of drugs, like acetate of lead, ergot, turpentine, &c., with local applications, whenever it is feasible, and to administer a saline purge. Frequently, however, all treatment fails, and the patient bleeds to death. At other times the bleeding stops of itself after profound anæmia, or even syncope, has been induced. In traumatic external hæmorrhage the part should be elevated, and careful pressure applied with a pad steeped in liq. ferri perchlor. It must be remembered, however, that excessive pressure is liable to cause gangrene. Ligature of a large artery has only once been successful hitherto, and cannot be recommended. Experience of the use of the actual cautery is not encouraging. In spite of its risks, transfusion seems justifiable as a last resource. The hæmorrhage resulting from extraction of a tooth should be treated by plugging the cavity with lint saturated with liq. ferri perchlor., which may be secured by a small gold plate wired to the adjoining teeth. Ligature of the common carotid, in one case, arrested the dental hæmorrhage. Extraction of teeth must on no account be attempted in a bleeder, and warning should be given of the risk of the operation when the disease can be recognised. Subcutaneous extravasations and blood-tumours must not be opened unless gangrene be threatened, but are to be treated by rest. It is important to deal promptly with the joint-swellings by means of splints and confinement to bed, as the affection is apt to become inveterate. It is hardly necessary to state that all cutting operations are inadmissible; even such measures as leeching, cupping, and blistering should be avoided.

Percy Kidd.

HÆMOPTYSIS FROM INJURY.—

The spitting of blood which takes place after injury to the chest is almost certainly pathognomonic of some lesion of the lung or trachea. It is characterised by the expectoration of frothy light-red blood, which, from being mixed with a large proportion of mucus, but rarely coagulates. Its amount is seldom large, and its colour speedily changes to the rust-red of pneumonic sputum. Should any very large amount be expectorated, it should lead to the suspicion of some previously existing cavity or tubercular disease of the lung. A penetrating wound involving the trachea and some large blood-vessel may, however, give rise to extensive hæmorrhage, which is coughed up, and thus simulates hæmoptysis. The bleeding in such a case is not exactly like an ordinary case of hæmoptysis. Although the blood is coughed up, it comes away more in gushes, is less frothy and deeper red in colour than in hæmoptysis, and has a greater tendency to coagulate. This arises from the blood of true hæmoptysis being more mixed with the mucus and air of the lung than in the cases where it comes from a wound in the trachea.

The blood of hæmoptysis may be distinguished from that coming from any other source by its light-red, frothy character, showing that it has been intimately mixed with the air of the vesicular tissue of the lungs. This admixture never takes place with the same completeness, even when the bleeding takes place from any other part of the air-passages. Thus the hæmorrhage of epistaxis is often abundant and florid in colour, but does not possess the frothy character. On the other hand, blood coming from the stomach or throat scarcely ever is florid, and is never frothy. Blood from the stomach is generally more or less dark in colour, in accordance with the length of time it has stayed in that viscus; and when it has been there sufficiently long to undergo the action of the gastric juice we get the well-known coffee-ground or black vomit of hæmatemesis.

The *treatment* of hæmoptysis from injury will be found detailed under PNEUMONIA, Traumatic. H. G. HOWSE.

HÆMORRHAGE.—This signifies the loss of blood from some part of the arterio-venous system. It need not necessarily flow out of the body, for bleeding, even to a fatal amount, may occur without external lesion. Sometimes, for instance, it will flow into one of the natural cavities. Thus the pleura or peritoneum may be distended with blood, constituting what is known as internal hæmorrhage; or blood from a ruptured vessel may be effused into the neighbouring areolar tissue, a condition known under the name of extravasation.

Bleeding may occur from arteries, veins, or capillaries. Arterial hæmorrhage is, as a rule, the most serious, owing to the high blood-pressure in the vessels, and thus, in a given time, a far larger amount of blood is lost from an artery than from a vein of the same magnitude; nevertheless a fatal hæmorrhage may readily occur from a wounded vein of any size. Capillaries or minute vessels, when injured, bleed freely for the moment, but rapidly close and the bleeding ceases. To this rule, however, there is sometimes a remarkable exception, and occasionally an uncontrollable hæmorrhage occurs from vessels too minute to be recognised by the naked eye. The peculiar constitutional state that leads to this form of capillary bleeding is known under the name of the HÆMORRHAGIC DIATHESIS.

Patients with this diathesis will bleed persistently from the slightest injury. The blood does not flow rapidly away, but escapes as a continuous slow oozing, and the writer has seen a case of death in these circumstances following a cut on the lip of the most trivial nature. In the victims of this diathesis capillary bleeding not only takes place from external wounds, but extensive subcutaneous extravasations occur from the slightest violence, or even spontaneously. In such patients the strain of a joint, instead of being followed by a synovial effusion, may cause the membrane to be filled with blood, while a blow so slight as not even to bruise a healthy person, will often, in such a constitution, be followed by an extensive discolouration and subcutaneous extravasation, a circumstance which may be usefully borne in mind in some cases of medico-legal inquiry.

CLASSIFICATION OF HÆMORRHAGE.—Surgeons generally classify hæmorrhage into primary, recurrent, and secondary.

Primary Hæmorrhage is that which takes place when a vessel is first wounded.

Recurrent Hæmorrhage. — Some confusion has arisen between the terms secondary and recurrent hæmorrhage, but a clear distinction is very necessary, not only as indicating a different pathological condition, but, also, as materially affecting the question of treatment. Recurrent hæmorrhage is the bleeding that recurs soon after an operation, generally speaking within twelve hours; very rarely it may happen as late as the second day. It is due to some vessel or vessels which have ceased bleeding at the time of operation, thus escaping ligature, but from which, when the patient becomes warm in bed and reaction is established, blood begins to flow. Recurrent hæmorrhage is not, as a rule, sudden and severe, like secondary hæmorrhage, for the vessel furnishing it is generally small. The blood begins slowly to trickle through or by the side of the dressings; or, if the wound has been united without a drainage-tube, the flaps will be slowly distended and separated.

Secondary Hæmorrhage.— This is the bleeding which occurs several days after an operation. It results from the obliteration of a vessel not being complete at the time the ligature separates, or from the vessel being opened by some sloughing or ulceration in its neighbourhood. The period of its occurrence depends upon the size of the vessel; the larger the vessel, the later, as a rule, secondary hæmorrhage occurs. In an artery the size of the femoral, it is generally between the tenth and the fifteenth day. The blood in these cases is often furnished by the main vessel, and it generally flows suddenly, in considerable quantities. Although the actual onset of the bleeding is sudden, it may be preceded by a slight staining or rust colour of the discharge, so that when a large artery is involved, the surgeon should be on his guard when the discharge becomes discoloured or blood-stained. Recurrent hæmorrhage, being due to mechanical causes, may occur in the most perfectly healthy individual. Secondary hæmorrhage, on the other hand, is only liable to happen in those who have some defective condition, either of the vessels or constitution, retarding the proper healing of the wound. Thus it is found that patients with either calcareous or atheromatous degeneration of their arteries are peculiarly liable to this accident; while drunkards, or others with broken constitutions, possessing tissues easily inflamed and slow to repair, are likely subjects for secondary hæmorrhage.

SYMPTOMS OF HÆMORRHAGE.—The symptoms of bleeding are both local and general. The local symptoms, if an external wound exist, are obvious, and it merely remains for the surgeon to distinguish whether the source of the blood be venous or arterial.

DIFFERENCE BETWEEN ARTERIAL AND VENOUS BLEEDING.—Arterial may be distinguished from venous hæmorrhage by observing the following points:—

1. The colour of the blood. 2. The method of its flowing. 3. The amount and position of pressure necessary for its control.

1. *Colour of the Blood.*—Blood from an artery is of a bright scarlet, while that from a vein is claret-coloured or purple. There are certain exceptions, however, to this rule. If the patient be under the influence of nitrous oxide gas or ether, the arterial blood becomes so dark as to resemble venous bleeding, while, on the other hand, venous blood, if trickling slowly from a wound, becomes much brighter than normal from its prolonged contact with the air.

2. *Method of Flowing.*—Blood from an artery escapes in pulsatile jets, synchronous with the heart's beat. In a deep wound, by the time the blood comes to the surface it probably no longer spouts, the intermittent stream having been converted into a more or less constant one, owing to the wound itself acting as a reservoir; but, even here, although there is no actual jetting, the stream has a pulsatile flow. Blood from a vein escapes in a steady continuous stream. It should be borne in mind that, although the flow from a vein is continuous, if the wound into it be small, and if there be any pressure between it and the heart, the jet of blood may be thrown out a considerable distance, a phenomenon illustrated by what occurs when a vein is opened for the purpose of bleeding.

3. *Effects of Pressure and Position.*—Arterial bleeding is only affected to a limited extent by position, or stopped by a considerable amount of pressure. On the other hand, venous bleeding nearly ceases on simple elevation of the part, while it can be completely arrested by a slight amount of pressure. Firm pressure over the main vessels of the limb will generally arrest bleeding, whether venous or arterial; but slight pressure of the part above the wounded vein immediately increases the flow, which at once stops on the same amount of pressure being exercised on its distal side.

When blood is extensively extravasated into a limb, the whole member becomes swollen, and has a tense, elastic feel, while the skin is usually mottled and discoloured with venous congestion. If the hæmorrhage be from the main artery, the limb is often cold, with diminished sensibility, while there is loss of pulsation in the vessels below the injured trunk, and not infrequently such cases run on into gangrene. It might be supposed that, when blood was thus extravasated into a limb from a wounded artery, there would be pulsation in the swelling; but this is rarely the case. This absence of pulsation is probably due to the cessation of the bleeding, or to its flowing but feebly at the time of examination.

In internal hæmorrhage the local symptoms depend on the situation of the bleeding. Thus, when the pleura is filled with blood, there will be physical signs of fluid in that cavity. In the peritoneum the local symptoms are often very obscure. If the hæmorrhage be extensive, there will be dulness in the flanks, as in dropsical effusion, for it must be remembered that the blood does not at first coagulate in serous sacs. In two instances of fatal hæmorrhage into the peritoneal cavity, which the writer had an opportunity of observing at St. Bartholomew's Hospital, there was considerable abdominal distension, while, in both cases, the vomiting was so persistent as to suggest the idea of intestinal obstruction.

GENERAL OR CONSTITUTIONAL SYMPTOMS OF HÆMORRHAGE.—These require to be carefully considered, for they often have to be solely relied upon for the diagnosis of internal bleeding, while, even in wounds, they form a valuable guide as to the amount of blood lost. The effects of bleeding depend, not merely on the amount but, in some measure, on the rapidity of the flow; thus, a sudden loss of blood, occurring in a few seconds from a large vessel, produces a constitutional effect far more marked than an oozing of the same amount extending over some hours. Individuals, too, bear bleeding very differently. Speaking generally, infants and young children bear hæmorrhage badly, and the same relative loss of blood that can be borne with impunity by a healthy adult, may, at the extremes of life, lead to a fatal termination, while patients, already debilitated by illness or previous hæmorrhage, often succumb to even a trifling loss of blood.

Constitutional Symptoms of Sudden Hæmorrhage.—Fainting, shock, or collapse is the first prominent effect on the body of a sudden copious loss of blood. The patient loses consciousness, and falls to the ground in a fainting fit. If the loss of blood be but slight, he will remain in this condition for a few seconds only, but if severe he may be in a state of collapse, hovering between life and death for a considerable period. The pulse is absent at the wrist, or at the most gives but an intermittent feeble pulsation. If the stethoscope be applied over the heart, its sounds will be scarcely audible, while its working is irregular and intermittent. Respiration is almost suspended, requiring close observation to detect the movements at all, the inspiration being extremely shallow and wholly diaphragmatic—occasionally, however, relieved by sighing or yawning. The extremities are cold and damp, while the face is bathed with a clammy sweat. Muscular debility is almost complete; even the power of the levatores palpebrarum is lost, the lids drooping over the half-closed eyes; a deadly pallor pervades the surface of the body, the blanched, bloodless condition of the lips, finger-nails, and conjunctivæ bearing unmistakable evidence of a failing circulation.

Should the case end fatally, the pulsations grow feebler, and the breathing more and more shallow, death stealing over so gradually that the exact moment of dissolution escapes observation. Even after the heart has apparently ceased to beat, a faint, quivering throb may now and again be detected for some minutes. In other fatal instances the patient rallies somewhat from his first collapse, and the condition of complete muscular debility is replaced by extreme restlessness. The sufferer tosses from side to side, vainly seeking repose, and it is with great difficulty that he can be kept quiet. It may so happen that the restlessness decreases as the patient gradually regains strength, or it may be but the prelude to a second collapse from which he never rallies. It is often many days, or even weeks, ere the patient recovers from the effects of severe bleeding, while elderly people sometimes never really recover, dying some months later from intercurrent disease starting in a constitution already debilitated by hæmorrhage.

Constitutional Symptoms of Chronic Hæmorrhage.— The symptoms of chronic hæmorrhage, which arise from small losses of blood frequently repeated during many weeks or months, are very characteristic. The whole complexion slowly assumes a faint yellow or waxy hue. The pallid lips and the blanched conjunctivæ clearly indicate the anæmic condition of the tissues. Muscular weakness, shown by a distressing breathlessness upon the slightest exertion, is always present, while the sudden assumption of the erect position produces giddiness or fainting. The lower limbs are apt to become œdematous, and the pulse, excessively soft, constantly exceeds its normal rate, while palpitation follows on any exertion. Noises in the head are commonly complained of. In these cases of chronic hæmorrhage the blood is at first of normal constituency, but it gradually becomes thinner and, from a diminished proportion of its solid constituents, grows so watery as rather to resemble a red-stained serum than the natural fluid.

NATURAL MEANS BY WHICH HÆMORRHAGE IS ARRESTED.— Before considering the treatment of hæmorrhage, it is necessary to understand Nature's method of stopping bleeding from divided vessels, for it is by aiding this natural process that many severe cases are brought to a successful issue, without the necessity for any active surgical interference. Nature's method may be considered under the headings *constitutional* and *local.*

Constitutional.—During the period of collapse the action of the heart is reduced to the smallest amount, the pulsations becoming so feeble as barely to keep the blood circulating. The blood accordingly ceases to flow from the wound, and thus the patient is prevented from at once bleeding to death when an artery of any magnitude is divided. During this temporary respite, time is allowed for those earlier changes to take place in and about the wounded vessel, which form the first line of defence against the recurrence of bleeding as the heart regains its power.

Local.—These affect both the vessel and the blood. An artery upon being divided at once retracts, from its elasticity, a short distance within its sheath, while, owing to the contraction of its circular muscular fibres the end becomes conical, thus materially diminishing its calibre at the divided point. The changes in the blood consist of the formation of coagula known as the temporary and permanent clots. The temporary clot is a simple coagulation of the blood. It appears to commence on the inner margin of the sheath, and, quickly increasing, only leaves a narrow channel through its centre, which channel rapidly becomes blocked up. Coincidently with this coagulation within the sheath and about the wound, the clot extends upwards within the vessel itself as high as the nearest collateral branch, closing the vessel by a soft blood-coagulum. The protection afforded by this temporary plugging of the vessel doubtless depends upon the distance to which the clot extends. Sometimes it is so slight as to be immediately washed away as the patient rallies; but often, frail as the protection may appear, it is sufficient to guard against bleeding until Nature has time to construct a more permanent barrier.

Permanent Clot.—If a divided artery be examined twenty-four hours after the cessation of bleeding, it will be found that a marked change is taking place in the constituents of the temporary clot. At its base —that is to say, at the line of the divided coats of the vessel—the clot has a whitish appearance, so that at this time it may be described as possessing a light-coloured base, which during the next forty-eight hours has extended upwards into the red blood-coagulum, causing, by the end of the fourth or fifth day, its total absorption. Under the microscope it can be seen that this white coagulum consists mainly of leucocytes, which have been climbing as it were into, and dissolving, the original blood-clot. The source of these leucocytes is apparently from the cut edges of the vessel, to which the base of the permanent clot is from the very first adherent, though there is some question as to whether they may not be in part derived from the endothelium lining the vessel. At any rate the endothelium rapidly disappears, the leucocytes of the clot becoming ultimately adherent to the inner coats of the vessel. The development of these leucocytes into fibrous tissue ultimately transforms the artery, as high as the nearest large branch, into a permanent fibrous cord.

By a proper understanding of the process just described, the successful treatment of hæmorrhage is more likely to be effected, since it explains why pressure, if properly applied, by allowing time for nature to seal the vessels with lymph, is often so successful a method of dealing with arterial hæmorrhage.

Treatment of Hæmorrhage.— This resolves itself into the general treatment of the shock or collapse induced by the bleeding, and the local measures required for the arrest of the hæmorrhage.

Treatment of the Collapse.—If the collapse induced by hæmorrhage is marked and profound, and the patient in the condition already described, the greatest care and gentleness will be demanded; for he is so near the invisible boundary dividing life from death, that neglect of the slightest precaution may place him for ever beyond the reach of surgical aid. To expose or roughly handle such a patient, or, above all, to lift him suddenly from the recumbent to the sitting or upright posture, is to court disaster. In hospital practice such a patient should on no account be lifted off the stretcher, but should be carried to the ward, and the stretcher be placed with a screen round it before the fire. The clothes must be rapidly cut off and the body covered with warm blankets, it being of extreme importance that the head be not raised or the body pulled about.

If the bleeding vessel has already been secured, the indication for treatment is to bring about reaction. Hot bottles may be placed between the thighs, under the arms, and over the pit of the stomach. The lower limbs should be slightly raised on pillows, so as to allow the blood to gravitate as much as possible towards the body. Hot dry flannels may be applied over the chest, while a sponge wrung out of very hot water may be placed over the region of the heart. Equal parts of hot brandy and water may be given. This should be done extremely slowly, drop by drop, on a quill pen. If given hurriedly it cannot be swallowed, and will run into the larynx. In extreme cases a subcutaneous injection of a few minims of ether by a hypodermic syringe has proved serviceable, while if the patient show no signs of rallying, direct transfusion of from four to six ounces of blood may be tried. *See* Transfusion.

If, however—as is not uncommonly the case—the collapse is due to violent hæmorrhage from some punctured wound of a deep vessel, which has spontaneously ceased to bleed before the surgeon's arrival, he should not be in too great a hurry artificially to bring about reaction. There is no time when an efficient coagulum is so likely to form as during the collapse immediately succeeding a sharp hæmorrhage, for, at this period of feeble circulation, the coagulum is not merely forming around the wounded orifice, but it is extending within the canal of the vessel itself, and every minute gained makes it stronger. Unless the collapse be very profound, surgeons should be satisfied with merely covering the patient with warm blankets. Brandy should on no account be given. Artificially to excite by stimulants a more powerful action of the heart is in these circumstances fatal. Nature has done her best to reduce the heart's power, and, if time be given, an effective clot will be formed; while a premature reaction, brought about by stimulants, may be followed by a breaking up of the clot and a recurrence of the bleeding. Urgent thirst is a common symptom of severe bleeding, and there is no reason why the sufferer should not be allowed a moderate amount of cold water, and small pieces of ice to suck are often specially grateful.

Local treatment of hæmorrhage.—The treatment of arterial bleeding will be found under ARTERIES, Wounds of; the milder forms of hæmorrhage from the veins or capillaries will be here considered.

TREATMENT OF VENOUS BLEEDING.—In an open wound there can be no doubt that bleeding veins should be tied. The old fear of inflammation following ligature of the veins has long since been proved to be utterly groundless. In punctured wounds, elevation of the limb on a pillow with a moderate amount of pressure directly over the bleeding point, or on the veins a little below it, effectually arrests the hæmorrhage. The use of the tourniquet or bandaging above the wound should on no account be permitted.

The veins of a limb can be closed by a far less amount of pressure than is required to arrest the circulation through the arteries, so that if a circular bandage or tourniquet be not applied so firmly as completely to stop the arterial circulation, it will, to a certainty, increase the venous bleeding, for the blood finds its way into the limb and cannot return. The blood thus retarded flows out through the wounded veins. It may be frequently observed that a severe hæmorrhage from a wound is at once stopped by removing all bandages and compresses which have been applied above the wounded part. Shortly, then, it should be borne in mind that the very pressure over the main vessels of a limb, so efficient in arterial wounds, may actually prove fatal to the patient, if employed for venous hæmorrhage. If a large vein has only been punctured, it will suffice to pick up the portion wounded and tie it without including the whole calibre of the vein. A wound of one of the intracranial sinuses by the trephine, or a compound fracture, bleeds very copiously; nevertheless it can be easily restrained if the patient's head be raised and the most moderate amount of pressure applied locally.

CAPILLARY BLEEDING.—This does not mean that the hæmorrhage necessarily proceeds from the actual capillaries, but that it flows from vessels too small to be distinctly recognised as arteries or veins. Thus it will sometimes be observed that, after an amputation, especially when an Esmarch's bandage has been used, after all visible vessels have been secured, blood will continue to ooze from a number of minute points. Hæmorrhage of a similar nature occasionally follows the evacuation of an abscess, from the minute vessels in its walls losing their support. It is in patients with the hæmorrhagic diathesis that a serious or even fatal bleeding may result from the division of the minutest vessels.

The troublesome oozing which may occur from the surface of a wound will nearly always cease when the sides are brought together or the flaps adjusted, but it is sometimes undesirable to close a wound when the oozing still continues. It is a common practice to dash cold water over the surface, but if the wound has been long exposed, and the surface is already cold, this often aggravates rather than restrains the bleeding. In these circumstances nothing answers better than rapidly bathing the stump with hot water. The temperature of the water should be 120° to 124°, that is, just about as hot as can be borne by the hand.

A troublesome bleeding sometimes occurs, in amputation, from the medullary canal of a bone; this can be stopped by pressing a small piece of beeswax into the spot. Capillary oozing is sometimes kept up by the presence of a clot, and a wound that has been dripping for some time will cease to do so if the coagulated blood be gently sponged away. The free exposure of the bleeding surface to the air is often a valuable resource in arresting general oozing, especially if care be taken that all clot be wiped away. Whether the exposure acts directly on the vessels or on the blood is unimportant; but it is certain that an oozing which has been continuing for a length of time may quickly cease, on exposing the flaps or surface of a wound freely to the air. In the oozing from an abscess-cavity it will frequently happen that, on washing out the collected blood, the bleeding will cease.

Pressure, carefully applied and evenly adjusted, is a form of treatment applicable to many cases of capillary bleeding, while, in positions where it cannot be applied, syringing with hot water should certainly be tried. Should this prove ineffectual, the wound may be washed out, or the abscess-cavity syringed with a solution of the subsulphate of iron, or, failing this, the wound may be touched with the actual cautery; while, as a last resource, and one that would very rarely have to be applied, the cavity may be plugged with strips of lint dusted with the subsulphate of iron powder.

For treatment of arterial hæmorrhage, *see* ARTERIES, Wounds of.

HARRISON CRIPPS.

HÆMORRHAGIC DIATHESIS.

See HÆMOPHILIA.

HÆMORRHOIDS.—A varicose condition of the veins of the anus and adjacent part of the rectum. The term is etymologically bad, as it refers to the hæmorrhage, which is only one, although often the chief, of many symptoms which characterise some forms of this disease. Piles, from the Latin *pila*, a ball, is better, as most of these varicosities present, at some time of their existence, a somewhat globular form.

Piles may be classed as external, intermediate, and internal, according to their situation, outside, on the margin of, or inside the anal orifice. This classification is practically useful, for the symptoms and requisite treatment will vary with their situation.

They occur very frequently, and few persons attain to old age without having them in some degree. This is explicable from the anatomy of the part. The anus and rectum being developed from different parts of the embryo, are supplied with blood from separate sources, and return it by separate channels. The rectum is supplied by the superior hæmorrhoidal artery, and the blood is returned by the corresponding vein, a radical of the portal vein. The anus and contiguous part of the rectum are supplied by the middle and inferior hæmorrhoidal arteries, and the blood is returned by the corresponding veins, radicals of the inferior vena cava. There is a free capillary communication between these vessels, so that any obstruction to the flow of blood through the portal vein or the inferior cava tends to produce passive congestion of this part of the bowel. This is further favoured by gravitation, as the veins of the portal system are valveless. Moreover, the submucous tissue of the rectum is very lax, to allow of the adaptation of the mucous membrane to the varying condition of the tube, which is sometimes completely closed, and at other times, during the passage of fæces, more or less considerably distended. The veins, therefore, in this tissue are less capable of resisting increased blood-pressure than in other parts. Thus, constriction of the mitral or tricuspid orifices of the heart, pulmonary emphysema, chronic bronchitis, cirrhosis of the liver, or abdominal tumours, may induce piles. The straining resulting from habitual costiveness, or from stricture of the rectum or of the urethra, or from enlargement of the prostate gland, is a frequent cause. The gravid uterus very frequently produces passive congestion of the rectum, and so causes piles. Active congestion of the part may be induced by constipation, unsuitable purgatives, high living, abuse of alcohol, venereal excess, and, in women, by uterine or ovarian affections. In some cases there appears to be an hereditary tendency to piles; but, as Esmarch well remarks, the tendency to excesses by which piles are produced may also be hereditary in these cases.

The *treatment* of piles must be general as well as local, and unless the exciting cause can be adequately dealt with, the local treatment can only be palliative. As a rule patients with piles may be advised to carry out Falstaff's resolve 'to purge, and leave sack, and live cleanly.' The purgative must not be irritant, and the confection of senna, or Carlsbad water, taken before breakfast, will usually suffice. The rectum should be injected with cold water after each motion. These precautions, with attention to diet and moderation in the use of alcoholic stimulants, will generally check the development of piles, unless there be some persistent obstruction to the return of venous blood, when the treatment must, so far as possible, be directed to the cause as well as to the result.

External piles commence as a dilatation of the subcutaneous network of veins around the anal orifice. As the integument is thin, the dilatations form livid projections, which are soft and easily compressible. If the congestion continue, it produces infiltration and chronic inflammation of the surrounding tissue, which subsequently undergoes cicatricial contraction, and so compresses or even obliterates the dilated veins. Firm incompressible folds of skin remain, which, if uncomplicated, and if due attention be paid to cleanliness, usually cause no trouble. They may produce pruritus or eczema, and sometimes become inflamed and painful. If so, they may be cut off with scissors curved on the flat. But if they are near the margin of the anus, care should be taken not to remove too much skin, or a troublesome stricture of the orifice may result. Sometimes one vein becomes considerably dilated. Thrombosis usually results, and the nodule, from its size, may cause inconvenience and is liable to irritation. It may become inflamed and suppurate. A longitudinal incision should be made in the pile and the clot be turned out. Some cotton wool should be placed in the wound and the patient should rest for the remainder of the day, for fear of hæmorrhage. The skin need not be removed, as in cicatrising it will contract.

Intermediate piles also result from passive congestion of the veins. If chronic, it induces hypertrophy and thrombosis. From their situation, at the margin of the anus, these piles are exposed to irritation and often becomes inflamed. As they are covered partly with skin and partly with mucous membrane, the latter may ulcerate, and so cause a purulent discharge or hæmorrhage. They often excite tenesmus, and there may be great pain during and after defecation, but this is not so severe or persistent as in so-called fissure of the anus, which, however, sometimes is a complication of this variety of piles. If their removal be contra-indicated, ice will relieve the inflammation, and the dilute nitrate of mercury ointment is a convenient application when they are ulcerated. Otherwise they may be excised with scissors, but, lest stricture of the orifice should result, it is better to remove only two-thirds of each pile, and the remainder will shrivel in cicatrization.

With internal piles there is usually active as well as passive congestion of the mucous membrane. As they are abundantly supplied with arterial blood they are of a bright red colour, and bleed very readily. There is often much mucous discharge. The veins are convoluted as well as dilated, and the hypertrophied sub-mucous tissue around and between them forms tumours which, on microscopic examination, resemble cavernous structures. As a rule internal piles are soft and compressible; but sometimes the hypertrophied sub-mucous tissue may become indurated, and the pile may resemble a fibrous polypus, from which it can be distinguished only by microscopic examination.

Internal piles may be sessile or pedunculated. The latter often protrude through the anal orifice during defecation, and their replacement is painful. It is usually effected by the fingers of the patient, or better by pressure with a soft sponge. In these cases the patient should arrange so that the daily action of the bowels should take place at bedtime, as the piles can be more easily replaced when the patient is in the recumbent posture, and the maintenance of this position during the night, and the dilatation of the cutaneous vessels from the warmth of the bedclothes, relieve the congestion of the bowel. Sometimes the protruded piles are strangulated by the sphincter muscle, and then sloughing and gangrene may result.

Internal piles, in an early stage, cause irritation and a sensation of heat in the fundament, especially after defecation. Sometimes there is mucous catarrh of the rectum. As the piles enlarge, and the mucous membrane atrophies from pressure, there is usually hæmorrhage. This may vary in amount, being sometimes slight, at other times considerable. If it be venous, resulting from congestion of the heart, lungs, or liver, the patient will be relieved. But if it be arterial, from active congestion of the bowel, it is injurious, and, if long continued, in neglected cases will produce symptoms of extreme anæmia.

The *diagnosis* of piles presents no difficulty. Perineal vegetations, condylomata, and cancerous tubercles, can scarcely be confounded with external piles, and the history of the case will prevent the possibility of such a mistake. Protruding internal piles are distinguished, by their irregular outline, from the uniformly annular protuberance of smooth or rugose mucous membrane in prolapse of the rectum. Such piles, however, are often accompanied by genuine prolapse of the rectum. An indurated internal pile, with narrow pedicle, greatly resembles a fibrous polypus, but the distinction is unimportant, as the treatment of both is the same—ligature of the pedicle and abscission of the growth. In fact, most internal piles are genuine new-growths of a nævoid character.

Treatment.—Daily injection of cold water and attention to diet and general health will suffice in many cases. Astringent injections are sometimes of service. They should be small in quantity, and should be administered at bed-time, so as to be longer retained and to act more thoroughly. The tincture of Hamamelis, one drachm to three ounces of cold water, is said to be useful. A suppository of the dilute nitrate of mercury ointment is useful in cases of catarrh. If there be arterial bleeding, it must be checked by operation. For this purpose sessile piles should be painted with nitric acid or the acid nitrate of mercury solution. The surface of the pile should be dried with cotton wool and the acid applied with a glass brush, but care should be taken to prevent the acid coming in contact with the margin of the anus, as this would cause great pain. The surface of the pile should then be again dried, and some carbolized olive oil (1 in 20) be applied. The patient should maintain the recumbent position for some hours after, and if there be much pain, ice applied to the part will give relief. Sessile piles may also be advantageously treated with the actual cautery.

Pedunculated piles may be removed by ligature or by the actual cautery. An aperient should be administered on the preceding evening, in order that the rectum may be empty, and an injection of warm water, immediately before the operation, will assist in bringing the piles well down. The patient should lie on the left side, with the thighs well flexed, and a strap, passed round the shoulders and under the right thigh, is very useful. The nates should be separated by an assistant. If the ligature be adopted, the pile should be seized with a pair of four-toothed forceps, and a groove cut in the mucous membrane at the lower border of the base of the pile with blunt-pointed scissors. The groove should be perpendicular to the wall of the bowel. The forceps should then be transferred to the assistant, who should make gentle traction on the pile at the moment when the loop of ligature is about to be tied round the base of the pile. The ligature should be of well-waxed hemp, and be tied as tightly as possible. The ends should be cut moderately long. If the base of the pile be broad, a curved needle, armed with the ligature, should be passed through the centre, and, the loop having been cut, the pile should be tied in two parts. If there be more than one pile, the others should be treated in a similar manner. The piles and the ends of the ligatures should then be passed up above the sphincter muscle, and, unless contraindicated, a morphia suppository should be introduced. Any external or intermediate piles should be cut off. Otherwise, however insignificant they may appear, they will almost certainly become inflamed and cause trouble to both patient and surgeon. The patient must remain in bed, and the bowels be kept inactive for some days. The diet should be simple and such as will not leave a bulky residuum. Alcoholic stimulants should be avoided. On the fifth morning some castor-oil or similar aperient should be given, and an injection of olive oil will facilitate the action of the bowels. The ligatures usually come away with the first motion, but if this does not occur, they should not be meddled with, as hæmorrhage might result. If the motion cause much pain, the use of a warm hip-bath will give relief. The patient should maintain the recumbent position until the part has healed, which usually occurs in about three weeks. If the wound be indolent, the compound tincture of benzoin or dilute solution of nitrate of silver (two grains to the ounce), are suitable applications.

If there be much pain after the operation, ice applied locally will usually give relief; but if this fail, then hot fomentations sometimes have the desired effect. If all bleeding has been thoroughly arrested at the time of the operation, there will very rarely be any recurrence if the patient be kept quiet and in the recumbent posture. Should any occur, if outside the bowel, it may be stopped by ligature, or by pressure with a pad of lint and a T-bandage. If it be from within the bowel, the piles should be drawn down by the ligatures, which were left long for this purpose, and the bleeding point touched with a pledget of cotton-wool steeped in the solution of perchloride of iron.

Retention of urine is a frequent complication. It results partly from the sympathetic congestion of the vessels at the neck of the bladder, and partly, perhaps, from the patient's inability to micturate in the recumbent posture. A catheter must, if requisite, be used, and the patient should not be allowed to sit or stand up, as hæmorrhage would most probably result. The difficulty is not experienced in all cases, and rarely persists for more than one or two days.

The inguinal lymphatic glands often become swollen and tender. They very rarely suppurate. If they do, a puncture should be made as soon as fluctuation can be detected, and, the pus having been discharged, the wound heals rapidly.

Pyæmia and tetanus, occasionally, but very rarely, result from this operation. All surgeons, who have had much experience in operating for piles, have probably met with such results; but the fatal cases are very few in comparison with the number of operations. Some surgeons employ antiseptic measures, such as antiseptic ligatures, washing out the rectum with carbolised water, salicylic wool, &c. These can do no harm, but a careful selection of cases to be operated on will probably be more effectual. If there be evidence of extensive renal disease, operation should, if possible, be avoided, and palliative treatment adopted.

The causes of tetanus are so little known, that the surgeon has no clue as to the cases in which it may be apprehended. Statistics seem to indicate that it may result from some epidemic cause.

The treatment of internal piles by the actual cautery dates at least from the time of Hippocrates, and latterly has been adopted by many surgeons in preference to the ligature, as causing less after-pain and allowing the patient to more speedily resume his ordinary mode of life. The amount of pain, however, seems to depend more on the idiosyncrasy of the patient than on the mode of treatment; and the resumption of active life, before the part has thoroughly healed, always involves the risk of peri-rectal inflammation, and possibly of abscess and fistula. The use of the cautery does not confer any greater immunity from fatal results. The preliminary arrangements are the same as for the treatment by ligature. The base of the pile should be compressed by a suitable clamp, and the pile cut off within a little distance from the clamp. The remainder should then be burnt off down to the clamp with the galvanic, or with Paquelin's, cautery. The clamp should then be cautiously relaxed and, if there be no bleeding, removed. If there be any bleeding, the clamp must be tightened and the cautery re-applied. The after-treatment is the same as when the ligature has been used.

The method of crushing, instead of cauterising, the base of the pile, has recently been advocated, and the method seems to answer well with purely internal piles where it is desirable to avoid the loss of any blood. A very powerful screw-clamp is employed, and it is important to keep up the pressure for fully two minutes, after which the pile may be cut off beyond the clamp and the instrument removed, without risk of hæmorrhage.

Except for the application of nitric acid, which is comparatively painless, an anæsthetic should be administered in all operations for piles, unless contraindicated by the general condition or desire of the patient. The objection that the piles may slip up while anæsthesia is being induced, is groundless, as a good assistant can always, when the patient is unconscious, evert the mucous membrane so as to bring the piles into view. The volitional aid of the patient, desired by some surgical writers, is unnecessary, although sanctioned by Hippocrates, who recommended that the patient should shout loudly during the operation, so as to thrust the piles further down.

Protruded internal piles, sloughing from strangulation by the sphincter muscle, may, if the patient's condition be otherwise good, be at once removed by operation. But if, as is usually the case, there be high fever, it is better to temporise, and with hot fomentations the sloughs speedily separate, and the cure is thus effected by nature.

Jeremiah McCarthy.

HÆMOSTATICS. *See* Hæmorrhage.

HÆMOTHORAX.—A collection of blood in the pleural cavity, arising generally from injury, and very rarely from disease. The latter condition is generally due to some morbid condition of the blood, as in purpura hæmorrhagica. In such a condition, the commencement of what would otherwise have been an acute pleurisy may be here ushered in by a violent hæmorrhage into the cavity of the pleura. The course and treatment of this state will be those of the condition primarily causing the morbid state of the blood, and need not be further described here.

Hæmothorax from injury is generally due to injury of the lung or of the intercostal vessels by a penetrating wound. It more frequently takes place when the external wound is a small one than when it is large. In the latter case the blood escapes externally; when it is small, on the other hand, the wound contracts, and the bleeding cannot take place externally; it must then either collect under the skin and fascia, producing a blood-tumour, or, if the pleura be wounded, it is poured into its cavity and constitutes a hæmothorax.

A hæmothorax always causes some dulness on percussion over the affected part. The dulness may occupy the whole of the side, when the amount of blood is sufficiently great to fill the pleural cavity. In such cases there is always more or less collapse of the lung. Or the blood may occupy only a portion of the pleural cavity—generally the part most dependent after the injury has been received. Thus, if the patient has remained propped up it will be towards the base of the lung, and if he has fallen into the recumbent position it will gravitate to the side on which he has fallen. In the severer cases, there is absence of the breath-sounds on auscultation, and deficiency of the vocal fremitus. In the more localised cases, the breath-sounds are not altogether lost, but are distant and deficient in intensity; and in the slightest cases, where only a thin film of blood is effused between the lung and the costal parietes, there may be scarcely any dulness, and the breath-sounds are nearly as loud as usual. In such cases as these, the auscultatory signs are always liable to pass, in process of time, into those of the severer form, from the setting up of an acute pleurisy by the blood-clot. This is especially the case when any foreign putrefactive material has been carried inwards by a small punctured wound. The acute pleurisy thus resulting is very often accompanied by extensive serous effusion (hydrothorax), and the mixture of serum and blood thus resulting gives rise to a condition which, when seen for the first time, is very difficult to distinguish from a pure hæmothorax. The differential diagnosis may partly be made by taking into account the *rapidity* with which the dulness formed. If it came on after three or four days, it will probably be serum only slightly mixed with blood. If it formed within the first twenty-four hours, the chances are that it is blood.

Hæmothorax may be accompanied by the usual signs of a wound of the lung (*see* Lung, Wounds of), or these may be absent if the bleeding has taken place entirely from an intercostal or other large vessel. If the accumulation of blood is very great, the signs of extensive hæmorrhage will be present—viz. great collapse, pallor, thirst, a small thready pulse, and great dyspnœa. The patient sits up in bed with the body bent forwards, the surface of the skin is cold and moist, the pupils become dilated, and there is often vomiting, followed by syncope. In such cases death may take place very speedily, partly from the loss of blood, partly from collapse of the lung due to the pressure of the blood upon it. In such extreme cases measuring the chest may afford some information, the affected side bulging and being less mobile than the sound one. It is, however, a very uncertain test, and cannot be much relied on.

In the less severe cases, air may be extravasated into the chest and become mixed with the blood (pneumo-hæmothorax). In such cases the succussion-sound may be present, and may be audible either to the patient or the surgeon. In the cases which survive for some days, ecchymosis begins to appear in the lower part of the lumbar region of the chest. This is never an early sign, is sometimes not present, and is due to the blood colouring-matter gravitating from the pleura in the direction of the quadratus lumborum muscle. It gives rise to a deep purplish stain of the integuments in this region.

Treatment.—The first consideration is, if possible, to put a stop to the hæmorrhage. Operative measures to this end are too often futile, and the uncertainty where the bleeding comes from will generally render all special exploration with this end in view unadvisable. If, however, it be quite certain that it is the intercostal artery which is the source of the bleeding, an attempt should be made to secure it. On account of the freedom of its anastomoses, this should be done by tying both ends, if possible, at the wound. This is often exceedingly difficult to do, and, where it is found impossible, various special proceedings have been advised to put a stop to the hæmorrhage. Of these it is only necessary to mention one—viz. the introduction into the wound between the ribs of a piece of linen (boracic lint will answer the purpose well), pushing the centre of the piece before the finger into the wound in the form of a cone. The centre of the cone is next filled up with sublimate wool, and the base of the cone is then drawn tight over a small ring and tied. This will make the cone swell out at the sides, becoming more spherical. A slight movement of withdrawal will then cause the part in the chest cavity to press strongly against the thoracic wall, and thus may occlude any bleeding point.

If the hæmorrhage take place from any of the large internal vessels, operative proceedings are useless; but if it be from the internal mammary artery, an attempt should be made to secure it at the wound. In operating on the dead subject this artery is easily secured by opening up the space between the costal cartilages; but in the living patient, where the parts are infiltrated with blood from a bleeding artery, this is often impossible, and it may be best in such a case to cut through and remove a costal cartilage, in order the more certainly to get at the artery.

Practically, in the majority of cases, operative measures for securing the bleeding vessel will be found impossible. Where this is so, when death is impending from the large amount of blood poured out into the chest, it is best to open up the wound and introduce a large drainage-tube into the pleural cavity. The chance of saving the patient in such cases is small; but the pressure upon the lung may be relieved in this way, and the immediate risk tided over. It is said that this measure is of no use on account of the rapidity with which the blood poured into the pleura coagulates. It is, however, the only possible measure in such extreme cases, and even if fluid blood be not reached and drawn off by the drainage-tube, it is possible that some of the serum, the result of the coagulation of the blood, may be got rid of and the immediate risk from the pressure of the blood-clot be thus removed. In the cases of lesser severity it is very unwise to interfere at all with the wound. Such cases should be kept as quiet as possible, the patient placed on the affected side, the wound (if there be one) closed by some antiseptic dressing, and the effusion of blood checked as far as possible by the administration of ergot (♏x doses of the tincture every hour at first, and afterwards at increasing intervals), by the application of cold to the surface in the shape of ice-bags to the thoracic parietes, and by almost total abstinence from food. Such cases not infrequently recover, especially where there is no external wound. They may, however, be complicated by the effusion of a large quantity of serum (hydro-hæmothorax), which may call for the operation of paracentesis thoracis (q.v.).

This operation should be done, if there be an external wound, by opening it up, introducing a long drainage-tube of medium size, and allowing the fluid to drain off antiseptically below the surface of carbolic lotion (1–40) placed in a basin. The drainage-tube should never be kept in very long, and when the effusion of serum appears to have ceased, it should be withdrawn, the wound closed, and the rest of the serum and blood-clot allowed to be absorbed by the natural processes. When there is no external wound, the removal of the serum is best accomplished by the use of the aspirating syringe. A puncture should be made through an intercostal space (generally the seventh), not far from the angle of the scapula, with a medium-sized needle, and the fluid be withdrawn with the aspirating syringe. Here again it is wise not to use too much exhaustive force, and, when the fluid begins to flow with difficulty, it is best to withdraw the needle and allow Nature to do the rest. Indeed, it is better to repeat the operation a second time rather than to risk doing too much at first.

To sum up the treatment in these cases; although operative measures should be resorted to, where possible, to put a stop to the hæmorrhage, in practice it will be found that but few cases can be successfully treated in this manner, and more must be expected from the application of cold to the surface, from the internal administration of styptics, and from starving the patient, than from any operation.

H. G. Howse.

HAINSBY'S TRUSS or cheek-compressor roughly resembles a double inguinal truss. It is applied so that the pads fit on to the cheeks, which they compress towards one another; it is used to take off the strain from the sutures after operations for hare-lip.

HAIR, Diseases of the.—These may be divided into four principal groups—(1) atrophic, (2) structural, (3) pigmentary, (4) parasitic. To the first of these belong the different varieties of baldness. The structural and pigmentary changes are also for the most part atrophic, but for convenience are usually considered in separate groups.

Atrophy.—The circumstances under which alopœcia or baldness occurs are very various; in its ordinary form it is only a senile change which is very common in men, and requires no special notice.

Premature baldness may be simply due to an hereditary tendency, in which case it differs but little from senile baldness; more commonly, however, it is the result of some affection of the scalp. Amongst the most common of these is excessive sweating. It is not unusual to find that Europeans, who live in tropical countries, become partially bald owing to this cause. This kind of baldness is by no means confined to men. Various forms of follicular inflammation and seborrhœa give rise to partial baldness. *See* Seborrhœa. Most acute diseases may produce a sudden arrest of the growth and a subsequent rapid shedding of the hair; this is common, for example, after fevers. Syphilis is especially liable to produce temporary partial baldness, which may be generally distinguished from ordinary baldness by the fact that the hair falls off pretty uniformly from all parts of the head, and is by no means limited to the crown and forehead.

Scars of the scalp, from whatever cause they may arise, always produce permanent bald patches; this is the case even with those produced by erythematous lupus, where the scars are of the most superficial kind. For other forms of baldness, *see* Alopecia Areata.

Structural changes in the hair are not very common; one of the best known is called *Trichorexis nodosa* or *Tricho-clasis.*

To the naked eye the hairs affected are marked with two, three, or more white bulging spots, and very slight traction causes the hair to break at these points. Examined under the microscope, the hair presents spindle-shaped swellings of the shaft, which ultimately burst near the middle of the swelling, the cortical portion giving way first, so that the partially divided hair has the appearance of two brushes, the bristles of which are interlocked. The white appearance at the point of fracture is probably due to the same cause that gives rise to the white appearance of the scales of psoriasis—that is, the introduction of air. This form of trichorexis nodosa is chiefly met with on the hair of the face. In another variety of the same disease, first described by Dr. Walter Smith and the writer, spindle-shaped swellings occur in the hairs of the scalp, which usually break with a clean fracture between the swellings, so that the white appearance is not often seen. The growth of hair is generally very poor and feeble in these cases.

Pigmentary changes, like baldness, are often simply the natural result of old age, but premature greyness (canities) is not uncommon. Sometimes it is the result of some hereditary tendency, but more commonly it is due to bad health, anxiety, and worry. As a local cause, neuralgia may be mentioned; a long-continued or recurrent neuralgia of the scalp will often give rise to grey hair, which is distributed over the region of pain. In alopœcia areata the first crop of new hair is generally grey, and, associated with that disease, patches of grey hair are occasionally met with where the scalp has never been bald.

For parasitic diseases of the hair, *see* Tinea Tonsurans; Favus.

Treatment of premature baldness is confined to the use of stimulating lotions to the scalp and the internal administration of suitable tonics. The best stimulating lotions are the different preparations of cantharides; one of the most useful consists of acetum cantharidis f℥ss., glycerine fʒij., sp. rosmarini ad f℥viij. This lotion is also one of the best in cases of premature greyness; cantharides being the best local stimulant for producing an increase in the pigmentation of the skin and hair.

Robert Liveing.

HAMILTON'S SPLINT for fractures of the femur is a compound of two long splints, which are united at the lower end by a crossbar; it is very useful for children, as it restrains their restlessness and allows of their being turned over without disturbing the fracture.

HAMMER-TOES.—In this affection the toes, especially the second, but occasionally the third and fourth as well, are drawn towards the sole of the foot, usually at the first phalangeal, but sometimes at the metatarso-phalangeal joint.

Causes.—These are:—(1) Crowding of the toes by ill-fitting boots. When these are too short or too small, with pointed toes, the first and fifth toes are driven under the others, which, owing to the scanty room, become displaced into the position of hammer-toes. Boots with heels absurdly high, by throwing the weight on to the front of the foot, will—especially if too small as well—have the same effect. (2) Contraction of the flexor tendons or weakness of the extensors. (3) Contraction of the digital prolongations of the plantar fascia. (4) In some cases the contraction of the toes may be partly reflex, owing to the presence of painful corns; but it is obvious that in these cases direct pressure will probably play an important part. (5) In another group of cases infantile paralysis, as indicated by the wasting, colour, and temperature of the limb, will be found to be at the root of the matter. (6) Occasionally, as in the variety of club-foot which M. Duchenne called hollow 'claw foot,' a hammer-like condition of the toes is produced by wasting of the interossei, the first phalanges being extended, while the last two are flexed upon the first. Whatever be the cause, 'hammer toes' may become a very crippling affection, especially after puberty, when more active life begins. Painful corns and bunions form over the distorted phalanges, or over the exposed heads of the metatarsal bones; and the pressure of the body is no longer evenly distributed over the phalanges, as these, from their distorted and stiffened condition, have lost their natural play.

Treatment.—This consists in first removing any cause, such as ill-fitting boots, remedying, as far as possible, by friction, shampooing, warmth, &c, the deficient action of any weakly muscles. The toes are to be straightened by means of tapes and splints. In early or slight cases these may be of whalebone, but in more advanced cases it is best to make use of a metal sole-plate, with slots cut out at the extremity, by means of which the affected toes are gradually straightened with elastic webbing or broad tapes. Such a sole-plate may be worn in the day-time within a large boot or slipper; it is always to be worn at night. In advanced cases, straightening will be impossible without the aid of tenotomy. This may be freely, if carefully, made use of in the case of contracted tendons and fascia. The former should not be divided opposite to articulations; the latter is best divided a little above the heads of the metatarsal bones. If the surgeon practise division opposite to the webs of the toes or along the phalanges, great care must be taken of the digital nerves, or troublesome numbness will result. The patient must always be prepared for some stiffness persisting in the toes—a condition of much less moment here than in the fingers. So, too, with regard to amputation, when the straightening of one or two toes proves difficult or very painful, they should be removed; this step will not interfere seriously with locomotion.

W. H. A. Jacobson.

HAMMOND'S SPLINT for fractures of the jaw is a framework of strong wire, which passes both in front of and behind the teeth at the level of their necks. The two pieces of the wire splint are laced together and to the teeth by binding wires passed between the teeth. Silver-plated copper wire does well for the framework, and finer silver wire for the binding wires.

HAMSTRING TENDONS.—*Contraction* of the hamstring muscles may be caused by painful inflammatory swellings in the ham, the pain from which is relieved by flexion of the knee. In painful conditions of the knee-joint, and particularly in 'white swelling,' and when the bones or cartilages are affected, all the muscles about the joint become spasmodically contracted; and as the flexors are more powerful than the extensors, the knee assumes the flexed position. Spasmodic contraction of these muscles is also seen in hysteria, and is occasionally excited by reflex irritation, as in some cases of phimosis. When this contraction is continuous over a long period, the muscles become permanently shortened and unable to relax to their former extent, so as to allow the joint to be fully extended: this condition is distinguished as *Contracture*. This also occurs when the muscles are permanently relaxed with their ends approximated. Thus, when in a case of morbus coxæ, the limb is allowed to remain flexed both at the hip and knee for many months, the hamstring muscles shorten, so that the knee cannot afterwards be extended.

Symptoms and Diagnosis.—These conditions are recognised by noticing that the knee-joint is constantly flexed, and that the attempt to extend it causes the hamstring tendons to start out under the skin as tense resisting cords. When only one tendon is affected, as the biceps in genu valgum, the knee can be extended, but, on attempting to bring the leg into a straight line with the thigh, the outer hamstring tendon becomes very tense. If flexion of the joint again relax the tense muscle, and the attempt at extension be met by a completely unyielding resistance always at the same angle, and if this resistance to extension persist during sleep or full anæsthesia, the condition is contracture and not simple contraction. Contracture is never established under a period of joint-flexion lasting over many months. Sayre states that it can be recognised by the fact that when the affected muscles are put upon the stretch, pressure with the finger along the tense tendons excites spasm in the muscles.

The *treatment* of contraction consists in (*a*) that of the disease causing it, (*b*) extension of the knee by some suitable splint and by weight-extension. Where the tendons are actually shortened they must be divided. *See* Tenotomy.

A. Pearce Gould.

HAND, Dislocations of Bones of the. Carpo-metacarpal Dislocations.— There is no case recorded in which all the metacarpal bones have been dislocated from the carpus. Erichsen gives a drawing of a cast he believes to have been taken from a case of the kind. It appears to be a mid-carpal dislocation forwards, of which there are well-authenticated instances, but which this author fails to describe. Hamilton mentions a case of dislocation backwards of the *four inner metacarpal* bones, caused by a bullet traversing the hand. The *second and third* metacarpal bones have been dislocated *backwards* by blows given with the clenched fist, and the second has been dislocated *forwards* by a hammer. *The metacarpal bone of the thumb* has been more frequently displaced. It may be dislocated *forwards* or *backwards*. The treatment in all these cases is to make extension on the corresponding finger and use pressure over the displaced bone. After reduction, a dorsal splint from the wrist to the end of the finger or fingers should be applied to keep the joints at rest for a fortnight. *See also* Carpal Bones, Dislocation of the.

Dislocations of the Fingers.—*Metacarpo-phalangeal* dislocations are rare, and single joints are more often displaced than the whole together. The writer has seen dislocation backwards of all the fingers at the metacarpo-phalangeal joints, caused by a fall on the fingers, associated with a transverse wound of the palm through which the heads of the four metacarpal bones could be seen. Reduction was easily effected, and the patient recovered with a useful hand. Dislocation of a *single finger* may take place in a *backward* or *forward* direction, of which the former is the more common. Of dislocation backwards there appear to be two forms: in one the phalanx is carried directly backwards and the finger is straight; the other is a dislocation by rotation of the phalanx around the head of the metacarpal bone, so that the articular surface of the former is in contact with the dorsal surface of the head of the latter. The first phalanx is over-extended and the two distal phalanges flexed. The index and little finger are, from their exposed situations, most frequently dislocated. To reduce the bone, extension should be made on the finger at the same time that pressure is put upon the projecting metacarpal head. Should reduction prove difficult, the surgeon may have recourse to the methods of treatment employed for dislocation of the thumb. *Interphalangeal dislocations* occur more frequently between the first and second phalanges than between the second and terminal. The phalanges may be dislocated *backwards*, *forwards*, or *laterally*. Backward dislocation is the most common, and may be reduced by simple extension, or by over-extension followed by flexion. The forward dislocation may be reduced by over-flexion followed by extension. Not infrequently dislocations of the fingers are compound, and in these cases the advisability of amputation or excision may have to be considered; but the surgeon should err, if at all, rather on the side of conservatism, as these dislocations are by no means always followed by stiff joints. For mechanical extension, the Indian puzzle, Charrière's forceps, or Levis's noose may be employed.

Dislocation of the Thumb.—The *metacarpo-phalangeal joint* of the thumb is more frequently dislocated than the joint of any other phalanx. The displacement usually occurs in a *backward* direction, but occasionally *forwards*. The dorsal dislocation is of two kinds: in the more common form the phalanx is dislocated by rotation around the metacarpal head, with which it forms nearly a right angle, the terminal phalanx is flexed and the metacarpal head projects towards the palm, so that in shape the thumb resembles a Z; in the other form the phalanx passes behind the metacarpal bone, so that its anterior edge rests against the back of the metacarpal head, and the terminal phalanx is straight.

Great difficulty has often been experienced in reducing these backward dislocations, even under chloroform. Various explanations of the difficulty have been put forward, but that which is generally accepted is that the expanded head of the metacarpal bone slips forward between the two heads of the flexor brevis pollicis, which grasp it and form a *boutonnière musculaire*. This is the view of Ballingall, Malgaigne, Fabbri, Vidal, and Hamilton. Hey and Dupuytren, on the other hand, attributed the difficulty to the lateral ligaments, but experiment on the dead subject almost always causes rupture of one lateral ligament, and this was found to have happened in a dissection by Lawrie of a dislocation caused during life. Pailloux, Michel, Lawrie, Roser, and, more recently, B. Anger, account for the difficulty by the interposition of a portion of the anterior ligament, which has actually been discovered in some cases. Out of three dissections, the long flexor was found on the inner side of the metacarpal head in two, and on the outer side in one. Reduction is most easily effected in the manner recommended by Fabbri. The metacarpal bone is pressed inwards and the phalanx over-extended to relax the flexor brevis. The posterior edge of the base of the phalanx is raised over the metacarpal head, and the thumb being gradually straightened, then flexed, the muscles assist in drawing the phalanx into place. Should this manœuvre fail, increased power of extension may be obtained by employing a clove-hitch of tape, the Indian puzzle, Levis's noose, or Charrière's forceps; but subcutaneous division of the outer head of the flexor brevis and any tight ligamentous band that may cause obstruction will probably be of more service. Humphrey has suggested making a small incision and introducing a blunt hook to draw the head of the flexor brevis and its sesamoid bone forward. Anger states that movements of torsion will sometimes succeed by disengaging the capsule, when all other means have failed. In cases of long standing, when the thumb is useless, excision of the joint may be practised.

Dislocation *forwards* of the thumb may be caused by falls or blows upon the dorsal surface when it is flexed. The head of the metacarpal bone projects behind, the base of the phalanx in front, and the thumb is shortened and extended. Reduction is much easier than in dorsal dislocation, and may generally be effected by flexion aided by traction upon the phalanges. Should this method fail, over-extension and traction might be employed.

Dislocation of the *terminal phalanx of the thumb* is the most common of phalangeal luxations. It may take place in a *backward* or *forward* direction, of which the former is the most common. Traction and over-extension is the method which succeeds best for reduction of the dorsal dislocation, and traction and over-flexion for the dislocation forwards. Not infrequently the dislocation is compound. If there is not much laceration such cases do not call for amputation. The writer has seen a case of compound dislocation backwards recover with a perfectly movable joint. R. CLEMENT LUCAS.

HAND, Fractures of Bones of the.—THE CARPUS.—Owing to its flexibility and elasticity, the gliding movement that is allowed between the various bones, and the protected position which it occupies in the interval between the larger framework of the forearm and metacarpus, the carpus is little liable to fracture. Several examples, however, of simple fracture—mostly of the scaphoid and semi-lunar bones, combined for the most part with fracture of the lower end of the radius, and produced by falls on the hand—have been recorded. Some have been due to direct violence. Compound fractures, produced by crushing, or by gunshot or other injuries, and associated with lesions of neighbouring parts, are less rare. In simple fracture it is sufficient to keep the hand and forearm at rest in a sling. In compound fractures only such fragments as are completely detached should be removed. Others must be replaced.

Prognosis is generally favourable, and should inflammation not extend to the radiocarpal joint, the movements of the wrist are not likely to be seriously impaired.

THE METACARPAL BONES.—From its isolated position and wide range of movement the metacarpal bone of the thumb is especially liable to fracture; next comes the second; the third, strong and supported on either side, most often escapes; the fourth and fifth are occasionally broken. The fracture is usually situated nearer the distal than the proximal end of the bone; and sometimes is multiple, or comminuted. Generally it results from direct violence, but is sometimes produced when a blow is struck with the closed fist, or by a fall on the knuckles. In young subjects 'fracture of the neck' of these bones is usually, in reality, separation of the epiphysis, except in the case of the metacarpal bone of the thumb, which has its epiphysis at the base like a phalanx. For treatment Sir A. Cooper advised that a large ball should be placed in the palm, and that to this the metacarpus should be securely bandaged. If used, the ball must be large enough to keep the phalanges partially extended, so that the head of the fractured bone is prevented from dropping, as it naturally does, towards the palm. Another and better plan is to mould gutta-percha splints to the palmar and dorsal aspects of the metacarpus (the fingers being left free), and to bandage these, carefully padded, to each other. Treatment must be continued for about three weeks.

THE PHALANGES.—Fracture of these bones is a very common injury, generally due to direct violence—machinery accidents, and the like; but sometimes produced indirectly. The first phalanx, the most fixed and the most exposed, is most likely to suffer. The fracture is generally compound, and associated with laceration of the soft parts of the finger. Mobility and crepitus are easily detected; displacement is seldom very marked. In comminuted fractures, even though extensively stripped of their periosteum, the fragments will generally survive; they should, therefore, not be removed unless they are already completely loose. If a joint is opened, it will not rarely recover, with little remaining stiffness.

The treatment consists of the use of a gutta-percha splint, moulded on the finger, in a slightly flexed position, and prolonged, for the sake of support, into the palm. This may, in simple cases, be removed at about the end of three weeks, when passive motion should be employed. In compound fractures the duration of treatment must vary with the case. HOWARD MARSH.

HAND, Surgery of the.—In the hand may be seen very early the effects of any general wasting disease, as shown by the falling in of those parts which in health should be full and rounded, so that the bones and joints are rendered more prominent, and the skin more puckered and transparent. A clubbed condition of the finger-ends and of the nails is often found to be associated with some obstruction of the circulation, as in congenital disease of the heart or in empyema, or as indicative of a phthisical tendency. The hands of idiotic children are often ill-developed.

In the diagnosis of affections in this region, whether resulting from accident or disease, it is of the utmost importance to determine the tissue which is most deeply implicated, and this is in many cases a matter of no little difficulty. Where swelling exists, there must also be ascertained whether any acute or chronic inflammatory process is present, and if not whether any new-growth is in progress. These questions are to be determined by the characteristics by which they are recognised in other parts; but the inflammatory affections of certain tissues of this region are known by special names—e.g. whitlow, ganglion, &c., which will be found described under separate headings, and the new-growths which may be met with are detailed later on.

Atrophy of the hand occurs under many conditions, and may be either partial or complete. In cases of infantile or other forms of paralysis affecting the whole or part of the arm, or even the hand alone, a general wasting of all the component parts ensues. In short, anything which interferes with the full use of the hand will cause a certain amount of atrophy through wasting of the muscular and other tissues which contribute to its roundness and proportions. It follows, therefore, after diseases of or injuries to the bones or arteries, but such atrophic changes as are consequent upon injury to nerves are very characteristic, the glazed and hairless condition of the skin being well marked, and the claw-like deformity of the fingers unmistakable. Atrophy of the interosseous muscles (so that the fingers cannot be divaricated), of the small muscles of the little finger and of the adductor of the thumb, is evidence of loss of power in the ulnar nerve.

Hypertrophy of one hand may ensue from its more constant employment in any severe labour which calls for increased power of its muscular tissue, and an example may be found in the right hand of a racquet or tennis player, which will become considerably larger than its fellow. But the more common form of hypertrophy is a congenital condition, and may affect the whole hand or, as is more frequently seen, one or more of the fingers, the others being of the normal size. This condition is sometimes, though rarely hereditary, and may or may not be symmetrical, or similar conditions may coexist in corresponding parts of the foot. There is a general hypertrophy of all the tissues forming the part, and not of the fat only, although in some cases this is the only tissue which is exaggerated. The elongated member is usually bent to one side, and being very slightly useful, such organs are very greatly in the way.

Gangrene.—Apart from frostbite (q.v.), gangrene very rarely attacks the tissues of the upper extremity. There are, however, certain causes of this affection which should be mentioned here, although the general consideration of the symptoms, &c., will be found under the proper heading. Thus gangrene of the fingers may follow severe injuries, crushes, tight bandaging, or may result from disease or obstruction of arteries. In the museum of the College of Surgeons may be seen a hand and forearm presented by the writer, which he removed from an elderly gentleman on account of gangrene consequent upon an atheromatous condition of the vessels. Injuries to nerves, particularly the ulnar, when followed by loss of sensation and by an ill-regulated state of the blood-supply, may cause gangrene, especially if there is added some slight injury to the part affected or the depressing effect of a low temperature. The absorption of ergot is sometimes the cause of gangrene in the fingers as well as in other parts, and a gangrenous condition of the fingers may result from acute inflammation, as in whitlow or septic poisoning. An affection has been described by Raynaud and others, which occurs in children as well as in adults, in which the parts become livid and in some instances gangrenous, from, as it is suggested, a spasmodic contraction of the arterioles. *See* ARTERIES, Diseases of.

Wounds of the hand and fingers are extremely common, and in proportion to their size are attended with considerable pain and hæmorrhage. It is perhaps owing to their frequency rather than to any other cause, and also to the very extensive supply of nerves to this region, which, especially in lacerated wounds, cannot but be largely implicated, that they are so commonly followed by tetanus. Simple cuts heal readily, and the only treatment required is to carefully clean the parts and extract all foreign bodies, and then, after adapting the divided edges by strapping or other means—stitches should be avoided, if possible, on account of the additional pain—they should be dressed with mild antiseptic lotions or ointments. As a general rule hæmorrhage from the fingers can be restrained without ligature of any vessel, either by means of compresses or by careful bandaging, or by raising the hand and flexing the elbow.

Lacerated wounds occur from crushes by falling weights or in machinery accidents, and their management calls for the greatest tact and judgment. The parts may be widely torn and the edges of the wound severely contused. The pain is at first dull, but afterwards becomes acute and violently throbbing, and the bleeding may be severe. When no joint is opened and there is no fracture of bone, every effort must be made, by careful strapping or bandaging, to bring the parts closely together, after all hæmorrhage has been arrested by torsion, or ligature if necessary. Lint with some antiseptic lotion, or the complete Listerian apparatus, should be applied, and the hand, bandaged to a splint, must be kept raised over the shoulder or on an inclined pillow. Where, however, fracture of a phalanx is found, or where a joint has been opened, it is necessary, in view of the future usefulness of the part, to amputate, and this should be performed, if sufficient soft tissue can be gained to form the necessary flaps, through the joint next above the seat of injury.

The whole or part of a finger may be torn off by machinery or by being caught when the body is falling, and at the same time a long portion of tendon may be drawn out from the forearm. If it be necessary, the distal end of the remaining bone must be removed, the flaps trimmed and treated as in the case of an amputation.

Of other injuries to which the hand and fingers are liable, fractures of the bones of the phalanges or of the metacarpals are among the most frequent, and the joints are liable to simple or compound dislocation, and to sprains involving, more or less, rupture of the ligamentous tissues. These injuries have no special symptoms, but in their treatment it is important to give attention to the desirability of keeping them fixed with splints, &c., for as short a period as possible, and to the early and frequent passive movement of the joints, which, if this point is neglected, are very liable to become stiff and to be very painful under any voluntary movements.

Foreign bodies are frequently impacted in the tissues of the hand. Among the substances most frequently found are needles, pieces of iron, glass, splinters of wood, &c. The point of entrance may or may not be seen, and the body may be at some distance from it, and will often become embedded, setting up no inflammation, and only giving pain when pressed upon or from the movement of muscles with which it is in contact. Under these circumstances it is very unwise to interfere by any incision, but it is sometimes possible to push the end of a needle through the skin and thus extract it. Grave symptoms are occasionally the result of the pressure of foreign bodies upon a nerve. Thus, patients have been known to fall in a dead faint whenever the foreign body was pressed upon, or the same cause will give rise to fits or symptoms of a tetanic character. Their early removal is then of importance, and Esmarch's bandage is of the greatest possible service, since, by emptying the parts of blood, the foreign body is more easily distinguished and removed.

Inflammation in the subcutaneous tissue of the hand follows wounds of the fingers or of the palm, or may originate spontaneously. When no wound exists through which the products of inflammation can find an issue, the dense nature of the integument of the palm causes tension in this region to be attended with considerable pain. It is evidenced by thick, brawny, red swelling, often exceedingly tender, and very soon œdema, which is often considerable, appears on the dorsal surface of the hand, and upon the anterior and lower part of the forearm above the wrist. When suppuration has occurred, the matter can be seen beneath the skin, but, owing to its thickness, fluctuation is not easily to be detected at an early stage. From the disposition of the palmar fascia pus, situated beneath it, makes its way either upwards into the forearm, or downwards into the fingers, between the openings of that membrane. For the same reasons it will sometimes penetrate the interosseous spaces and present upon the dorsal surface. The lymphatic vessels generally share the inflammation, and their course is marked by red lines running up the forearm, and by swelling and tenderness of the lymphatic glands above the elbow and in the axilla. The constitutional disturbance generally runs high, and the destruction of tissues is frequently very extensive. Should pus find an entrance into the synovial sheaths, it will not only form a large fluctuating mass in the palm, but will bulge above the annular ligament by which it is confined laterally. Such inflammatory swelling can hardly be mistaken for the cold, chronic distension of the sac which constitutes a ganglion, but there is sometimes difficulty in determining the presence of matter. When circumscribed in the palm, mistakes may easily be made between it and the inflammation surrounding a thorn or other small impacted body, or suppuration of a bursa which often forms beneath the hard cuticle of labourers or artisans. *See* WHITLOW.

Treatment.—So soon as the presence of matter can be definitely ascertained, a deep incision should be made at the most tender point in the palm, where generally some yellow spot indicates the tendency of pus to come forward. If the abscess has presented above the annular ligament, a free incision must also be made parallel and internal to the palmaris longus tendon, and a drainage-tube inserted. The hand must be kept raised, and frequently fomented with hot water to which some carbolic acid has been added, and warm lotions of boracic acid should be constantly renewed, and should embrace not only the hand, but the whole of the forearm. The œdema and inflammation being subdued, no time should be lost in gently exercising the movements of the wrist, hand, and fingers, as the contraction which occurs if this is neglected forms a serious complication of the affection.

Contractions of the fingers or of the hand are found to result from burns, in which case the density of the scar-tissue renders the malady very intractable, and the same condition, in a minor degree, follows deep or extensive wounds, in which the fascia or tendons are involved. Contraction of the fingers is sometimes met with as a congenital affection, and in the subjects of hereditary syphilis. But there is a well-recognised condition in which the fascia only is implicated, and not the tendons, occurring most frequently in men, at or about the middle period of life, sometimes with a history of hereditary gouty tendency. *See* DUPUYTREN'S CONTRACTION.

Caries and Necrosis of the metacarpals or phalanges is not rare, as the result of syphilis or struma, or sometimes of severe injury or inflammation of neighbouring parts.

Dactylitis is a condition in which the medullary canal of a phalanx—generally the distal—becomes distended with inflammatory products. It may be due to scrofula, when occurring in children, and is marked by a thin, red, shiny condition of the skin, which is distended over the subjacent parts. The periosteum is thickened, and the compact tissue of the bone is destroyed; caseation with formation of pus takes place and sinuses form, through which dead bone can be felt and may be discharged. When resulting from syphilis, whether acquired or congenital, there is a gummatous periostitis, which does not always commence in the bone, but may spread from the sheath of the tendons, or from the fibrous tissues of the fingers, and is followed by softening and necrosis.

The *Dislocations* of the phalangeal, or of the metacarpo-phalangeal, articulations can only be confounded with severe sprains, and either form of injury is followed by chronic thickening of the joint. It is advisable, after either, to commence passive movement of the joint as early as possible, in order to avoid the stiffness and pain on movement which result from prolonged rest. These joints are liable to all the diseases which commence in synovial membrane or in articular ends of bone, and are more particularly the seat of the chronic affections of joints which occur as the result of gout or rheumatism, in which, as well as in arthritis deformans, the contour of the articulations is greatly altered and deformed.

Dislocations of the wrist-joint need to be diagnosed from separation of the lower epiphysis of the radius, or Colles' fracture (q.v.), and from acute effusion into the sheaths of the extensor tendons. The diagnosis may be made by noting the position of the styloid processes of the radius and ulna, which in fracture retain their normal relation with the bones of the carpus; while in dislocation the carpus is placed in front of or behind them. Disease of the wrist-joint may commence in the synovial membrane, as a result of injury, rheumatism, syphilis, or septic poisoning, but more commonly results from scrofulous disease of the carpal bones, and, from whatever cause originating, the swelling is most marked upon the dorsal surface, the hand lies semiflexed, and soon shows signs of wasting, and crepitus is detected at an early period from the destruction of the cartilages covering the bones.

Warts very frequently arise upon the hands of persons engaged in dissecting or making post-mortem examinations, but are also often found upon the fingers of children without any apparent cause. *Chilblains* very frequently occur in this region in persons with feeble circulation. The possibility of a *Chancre* must always be remembered in the case of a small obstinate sore with sluggish granulations and spongy surface, situated upon the end of the finger or at the edges of the nail in a medical man or nurse liable to contagion.

Of the affections of the nails *Onychia* needs mention here, and is a form of ulceration commencing in the matrix. The origin may be due to some slight injury, and the disease is then characterised by redness, heat, and swelling around the edge of the nail; pus soon appears underneath it, and the nail itself becomes altered in colour and is gradually exfoliated. Another form of the disease is due to syphilitic ulceration at the side of the nail, and is characterised by large granulations at the root of the nail, from which a foul sanious pus is discharged. The new nail which follows is badly formed. Treatment consists in removing as much as possible of the diseased nail, and dressing the granulations with iodoform or nitrate of lead. In the syphilitic form black wash or powdered calomel soon reduces the granulations.

The *joints* of the fingers often become enlarged, as a result of former injury, but in old persons such enlargement is more commonly due to rheumatic thickening of the ligaments. It is greatest, however, and is the source of much pain and limitation of movement, when caused by the deposit of urate of soda in the ligaments or around the ends of the bones, as occurs in persons of a gouty habit. Allied to these two conditions is the affection found in these as well as in other joints, termed rheumatoid arthritis, by which also the fingers suffer great deformity. The parts principally enlarged are the ends of the bones entering into the articulation. *See* CHRONIC RHEUMATIC ARTHRITIS.

The favourite site of cartilaginous tumours or enchondromata is found in the fingers, and they are known by their slow growth, their round nodular outline, and by the fact that, though commencing singly, they usually become multiple and affect many of the bones. Of the other tumours which are found to occur about the hand and fingers few need special mention, since the diagnosis must be based on those rules which are laid down for similar new-growths in other parts of the body.

JOHN H. MORGAN.

HANDKERCHIEF BANDAGE.—See *Esmarch's triangular bandage*, under BANDAGES.

HARE-LIP is the term conveniently used for expressing the existence of a congenital cleft in the upper lip. The term is incorrect, since in the hare the cleft occupies the exact median line of the lip, whilst in the human subject the defect is never found in the middle line, but to one side, or on both sides of it. The cause of the defect is a more or less complete arrest in the process of the development of the lip; it seems more than doubtful if the theory of 'maternal impressions' has any direct association with it. In the fifth week of fœtal life the median part of the upper lip is represented by a flap, which is descending from the front of the cranium in connection with the fronto-nasal plate. The lateral parts of the lip are developed from the coverings of the superior maxillary processes, which, extending inwards, are eventually fused with the descending flap at a short distance from the median line. If a unilateral arrest of development take place, a *single* hare-lip will be the result; but if, as less commonly happens, the arrest be symmetrical, the deformity will be *double*. This latter condition is often associated with extreme unsightliness. The cleft of one side or of both sides may extend into the nostril. Sometimes, however, the defect is represented by but a faint notch, or a slight depression on the free border of the lip. Or the apex of a slight triangular gap may be continued upwards as a slender white line, as if Nature herself had been attempting a plastic operation, with only partial success.

Hare-lip sometimes disfigures several members of the same family. Often it is complicated with cleft-palate, and the median piece of the lip, in the case of the single or double defect, may be attached, together with the intermaxillary bone, to the projecting nasal septum. Hare-lip much more frequently affects the male than the female.

The proper age for operating varies with circumstances; the child must be in the most favourable surroundings, and in the best state of health attainable. If the cleft in the lip be slight, and do not materially interfere with the infant's power of sucking, the operation may be conveniently deferred until after the weaning. If it be unassociated with defective palate, the sooner that it is closed the sooner will the infant be enabled to take the breast, and so to flourish. In such cases the operation may be undertaken with advantage and success within even a few hours of birth. Possibly at so tender an age the risks of the patient suffering from shock or hæmorrhage are greater, but for the sake both of the infant and the mother the defect should be dealt with, at any rate, within the first few weeks of cradle-life, provided that the general condition appear favourable. The early closure of the fissure has an important and beneficial influence in bringing together the sides of a palatine cleft.

Certainly it is impossible to over-estimate the importance of providing the infant with the power of feeding at the mother's breast. If the palate be widely cleft, or for any other reason the operation be deferred, unusual care and attention will be required for the infant's proper nourishment. These little patients are often brought to the surgeon in so thin and miserable a condition, that he is compelled still further to delay operation in order that their strength may be improved. When the infant cannot suck, the mother's milk should be drawn by a breast-pump and administered in a warm spoon. Failing this supply, equal parts of fresh cow's milk and water, with a pinch of salt and a little sugar of milk, should be used; and when being fed, the infant should be kept as upright as possible, so that the fluid may run easily into the pharynx. If he be sick after food it should be given in smaller quantities and at shorter intervals, and if cow's milk is being used it may be still further diluted. Condensed milk and the patent foods generally are, in the writer's experience, ill-adapted for the nourishment of these patients. The infant with hare-lip who is being reared by hand should be kept well covered in flannel, and his body and limbs should be rubbed, after the morning and evening warm bath, with cod-liver oil. The nurse who can produce a well-nourished infant, the subject of hare-lip and cleft palate, deserves high praise, many of these infants perishing from sickness, diarrhœa, and exhaustion.

Single Hare-Lip.—In every instance the operation for hare-lip demands the administration of an anæsthetic, fineness of adjustment and expedition being incompatible. Chloroform answers well, and it may be administered on a fold of lint just large enough to cover the mouth and nostrils; the stomach should be empty. The upper part of the infant's body should be wrapped round with a towel, so that the hands and arms may be fixed. In private houses a low chest of drawers forms an excellent operating-table; it should be placed in a good light. The operator will find it convenient to stand at the head of the patient, having the chloroformist on his left hand and the assistant on the right. The first, and a most important step, consists in making a superficial incision in the mucous membrane where it is reflected from the back of the lip on to the gum, and then completing the separation by tearing up the fold with the handle of the scalpel, so as thoroughly to free the lip of its maxillary attachments; this should be done to even far out on each side of the fissure.

The old-fashioned way of operating on an uncomplicated hare-lip consisted in stripping off the mucous membrane from the top of the fissure to the border of the lip on each side, and securely approximating the fresh surfaces; but by this plan the site of the original fissure was generally marked by a permanent and unsightly notch on the free border of the lip. A better plan, one which involves less sacrifice of valuable tissue, is to remove the thin strip of mucous membrane down the poorer side of the fissure, and to continue stripping off a thin layer round the blunt angle of the lip, and for a considerable distance along its free border. Then, from the opposite side of the fissure, a layer is dissected downwards; but, as the edge of the fine-bladed scalpel approaches nearer to the lower border of the lip, it should be turned obliquely, but boldly, outwards through the tissues of the lip. This having been done, a long strip hangs down from the lip, slender at the tip, but connected with the substance of the lip by a wide base. When the edges of the fissure have been brought together, this slip is bridged across the bottom of the vertical wound, and its raw surface attached by sutures of horsehair, or fine silver wire, along the border of the other side of the lip which has been already prepared for it. If this bridge do not come smoothly across the fissure, a slight extension of the oblique cut may be required. When the bridge has been carefully adjusted, all the thin tail of it which is not wanted is to be cut off in a tapering manner, so as to leave a point of mucous membrane to lie along the border of the lip. After the insertion of all necessary sutures the line of incision will look like a widely-spread inverted λ, the vertical part of which marks the site of the old cleft, a short limb extends into the conservative side of the lip, whilst the other and almost horizontal limb stretches along the opposite side of the lip, along the line of the transposed mucous membrane. In planning these incisions, care must be taken that the lines of the mucous membrane be evenly arranged. If the red flap be left deeper on one side of the lip than on the other, an unavoidable and permanent disfigurement results. For arresting bleeding from the coronary arteries during the operation, the finger and thumb of a dexterous assistant are better than any mechanical compress; the chloroformist will take charge of the left side of the lip. Blood is to be kept from getting into the mouth by the use of fragments torn from a clean sponge.

As quickly as possible a fine harelip pin is passed well through the substance of the lip, at about a third of an inch from the sides of the fissure, and reaching to the mucous membrane, so that the coronary arteries may be secured by a twisted suture of worsted or silk, not too tightly applied. A second pin is inserted higher up the lip. For a simple and narrow cleft the pins may not be absolutely necessary, but the writer invariably uses the lower one, leaving it in for twenty-four hours. If it be left in longer, a permanent scar may indicate its site. Many fine sutures are to be used, and it is important that some be inserted on the posterior aspect, the lip being gently everted for the purpose; these last sutures keep the saliva and food out of the wound. As the sutures are being inserted, the lower pin may be found to require readjustment.

The pins having been cut short with wire nippers, and the skin having been washed with a perfectly clean scrap of sponge, a morsel of lint is tucked under the ends of the pins to keep them from pricking the lip. Then a small piece of dry lint is placed over all, and secured by a piece of Seabury and Johnson's adhesive rubber plaster, cut like an hour-glass, and long enough to reach almost from ear to ear. There is much art in applying this piece of strapping. A broad end is to be firmly attached to one cheek, so that the narrow part of the strap falls over the middle of the lip; with the finger and thumb the two cheeks are to be drawn together, so that all the slack of cheeks and lip seems gathered below the nostrils, and then the other end of the strap is to be fixed in the hollow of the other cheek. In this way all strain is taken from the sutures. The cheeks being grasped in this way by the finger and thumb each time the strapping is removed, or the wound inspected, there is little risk of the parts being disturbed. Collodion is not required; it may be that its application causes unnecessary irritation.

For removing the pins it is not necessary to disturb the dressing, which by this time is forming a firm scab over the lip; the end of the pin should have been left uncovered by the strapping, so that it can easily be caught by a pair of sequestrum-forceps, and loosened by being gently twisted round, in order that it may the more easily be withdrawn. During this manœuvre the lip should be steadied by the finger and thumb. With a small piece of sponge, and a pair of dressing-forceps, the nostrils may be cleaned out from time to time. Three or four days after the plastic operation, the incrusted dressings may be cautiously detached, and one or two of the sutures removed if they have done their work. If the transplanted paring of red membrane appear loose and unsatisfactory, it must be left uninterfered with; it may require some trimming and adjustment on a future occasion. To allow the infant to suck before the fourth or fifth day would be likely to disturb the union of the paring. The invention of trustworthy and waterproof strapping has rendered unnecessary the use of Hainsby's truss for keeping together the sides of the lip.

Double Hare-Lip.—The treatment of double hare-lip is conducted on the same principles as those just enunciated. The rounded or oblong flap of skin, which descends from the nasal septum, must have its red mucous borders carefully pared off; and the outer borders of the cleft should be treated on the conservative principle, the paring being dissected downwards and left attached to the lower borders of the lip by a wide base. These two dependent flaps will afterwards be trimmed as short as may be necessary, their raw surfaces being brought together along the lower border of the median flap, to fill up the gap, and even to form a prolabium. Both sides of the fissure should be dealt with at the one operation, and two hare-lip pins will be used with advantage, but they should be withdrawn at the end of the first twenty-four hours.

Complicated Hare-Lip.—When either single or double hare-lip is complicated with a cleft palate and a projection of the intermaxillary bone, there is no urgency for the performance of an operation, as the closure of the labial cleft alone would be of little advantage in the feeding; but even in this case the lip should be operated on, the child being well, long before the end of the first year. Often the intermaxillary bone, firmly connected with one side of the hard-palate, is so much twisted forwards and outwards that it offers a serious impediment to the success of the operation upon the lip. In these circumstances the projection must be forced back into the intermaxillary gap some days, at least, before the lip is dealt with. The twist may be given to the bone by a strong pair of sequestrum-forceps, the blades of which have been carefully surrounded with lint, so that their pressure may not injure the bone or the mucous membrane. During the subsequent day or two a piece of adhesive plaster secured along the lip will suffice to steady the repressed bone. If the intermaxillary projection be associated with a bilateral fissure of the front of the palate, it may be far advanced upon the nasal septum, to which it is attached posteriorly. It will then be advisable to remove a triangular segment from the septum, by means of strong scissors or cutting pliers, before the repression of the mass is proceeded with. Sometimes one is greatly tempted to remove the intermaxillary bone altogether; but as it will prove very useful in filling the front of the palatine cleft, every effort should be made to get it back. Its removal would certainly be followed by a falling back of the upper lip. Moreover, in it are the germs of the central incisor teeth, and perhaps, also, of one of the lateral incisors in addition. When all local disturbance has quieted down, after the thrusting back of the mass, the lip may be dealt with on the principles described above.

If the intermaxillary bone be found eventually to be useless, or possibly an impediment to the closure of the cleft, it can at any time be taken away; but it should always have every chance given it. If the incisor teeth come through horizontally or obliquely, and the dental surgeon do not succeed in imparting to them a right direction, they must be extracted. When, as sometimes, though rarely, happens, the intermaxillary bone is advanced to the utmost, and attached to the tip of the nose, it must, probably, be sacrificed; but even then the median piece of the lip which partially covers it should be turned down to form a greatly-wanted columna for the nostrils.

If, after even the most careful operation, the promises of a satisfactory result end in suppuration and disappointment, all hope need not be laid aside. Attention must be given to the child's health, and still stricter inquiries be made into the condition of drains, sinks, and closets; the raw surfaces must still be brought and kept together by adhesive plaster, and, later on, feeble granulations stimulated and improved by judicious scraping. Thus it may be possible to secure an excellent result after all; and a year or two later any unnecessary and unsightly scarring may perhaps be lessened by operation.

Edmund Owen.

HEAD-INJURIES, Diagnosis of.—However trifling an injury to the head may appear, it ought never to be lightly regarded. The importance attached to such lesions is not so much due to the mere implication of the scalp and skull, as to the degree in which the brain and its membranes are involved. They ought to be estimated primarily according to the amount of extracranial injury, and, secondarily, as to the probability of the brain and its membranes becoming affected. Without any primary or secondary implication of the brain or its membranes, a fracture of the skull, even when compound, is of much less importance than a simple cerebral contusion or laceration. Owing to the intimate anatomical relations existing between the external and internal parts of the head, amounting in some parts to direct continuity of structure, inflammatory action is apt to spread from the former to the latter. So, a small scalp wound becoming affected with inflammation may lead to a fatal issue. Primary symptoms cannot be relied on as a sure sign of the amount of cerebral injury, as in many cases ultimately proving fatal the primary indications are extremely slight, or completely absent. In other instances, the symptoms may be very alarming at the outset and may yet pass rapidly away, the patient remaining in good health afterwards. A case which came under the writer's observation aptly illustrates the former of these statements. A man received a blow on the head while at his employment. He considered it a trifle, and continued at his work for three days without complaint or reference to his injury. But on the fourth day he was rather suddenly seized with symptoms of compression, from which he died. The post-mortem examination showed a large clot of blood over the posterior aspect of the left hemisphere. There were no inflammatory products.

Although, as a rule, the probable amount of injury sustained may be estimated by the degree and kind of violence used—and information on this point is of great value—still it cannot be too implicitly relied on, as comparatively slight violence has at times produced serious lesions. A blow on the head with the naked fist would not be expected to produce a fracture of the skull accompanied by a serious brain-lesion; but such a thing has occurred. A man received a blow on the eye from a comrade. He neither fell, nor was his head driven against any object whereby the effect of the blow might have been increased. Yet that man sustained a fracture of the orbital plate of the frontal bone, with laceration and extravasation of blood into the corresponding frontal lobe, from which he died. The history of the accident may serve to indicate whether the lesion produced is likely to be diffuse or local. A fall upon the head or a blow from a heavy weight is likely to be followed by a widespread injury; while a local lesion is most likely to be produced by a blow from a pointed instrument. It must not be overlooked that the presence of constitutional disease will materially affect the prognosis in any traumatic lesion of the skull or its contents. Thus such an injury to the head as might be readily recovered from by one in good health, would not improbably induce serious or fatal results in one suffering from Bright's disease, through the occurrence of secondary inflammation or its consequences. In certain cases of cerebral tumours, the first indication of their presence has followed upon slight injuries of the head, and the symptoms of the disease have been mistaken for those of the injury.

Though the brain is spoken of as a single organ, it is made up of a series of centres, each with definite functions. Physiologically it may be divided into motor and non-motor areas, the latter including the portions of the cerebrum situated in front of, below, and behind the motor area.

All are agreed in regarding the ascending frontal and parietal convolutions along with the paracentral lobule as the chief motor centres. Some are inclined to limit the motor area to these, since they are the parts which have been most clearly demonstrated in man as regulating the motor functions. Those who argue from physiological investigations on the lower animals include, along with the above-mentioned areas, the bases of the three frontal convolutions and the postero-parietal lobule. There is still considerable diversity of opinion as to the particular spots in those areas to which the special motor functions ought to be relegated. To some extent this may be accounted for by the fact that the data have been derived from different sources—in man from clinical and pathological observations, in the lower animals from direct physiological experiment. As might be expected, the conclusions of the latter are the more advanced and more minute. But even from the side of experimental physiology all observers are not quite at one. A few of the main points may be here briefly alluded to.

Charcot and Pitres place the centre for the motor power of the arm in the middle of the ascending convolutions, and especially in the middle third of the ascending frontal. Hitzig and Ferrier concur in placing the centre for these movements in the upper part of the ascending frontal.

The centre for the motor power of the lower limbs, according to Charcot and Pitres, is in the paracentral lobule. Ferrier places it in the postero-parietal lobule; while Hitzig locates it in the ascending frontal, immediately below the centre for the movements of the arm. Charcot in this localisation agrees more nearly with Ferrier than with Hitzig.

Among the associated monoplegias, Charcot and Pitres attribute those of the arm and face to lesions of the inferior half of the ascending convolutions; those of the face and tongue to very limited lesions of the inferior extremities of the ascending convolutions, especially that of the frontal; and those of the arm and leg to lesions in the superior half of the ascending convolutions. Ferrier goes further and localises other centres of movement as follows—of the hand and wrist, in the ascending parietal; of the facial muscles, in the middle third of the ascending frontal (Hitzig agreeing in this) and in the base of the second frontal; of the mouth and tongue, in the lower third of the ascending frontal and in the base of the third frontal (the former portion agreeing with the conclusions of Charcot and Pitres); of the lateral movements of the head and eyes, in the posterior third of the first frontal and the corresponding part of the second frontal.

Ferrier defines the sensory zone in monkeys as that portion of the cerebrum which lies posterior to the motor zone. In man it may be said to lie below as well as behind the motor zone. In it the centres of sight, hearing, touch, smell, and taste are situated. He particularises as follows. The sight centre is located in the angular gyrus, and embraces also the adjoining part of the occipital lobe. The centre for hearing is seated in the superior temporo-sphenoidal convolution. The tactile centre is in the hippocampal region; while the centres for smell and taste are situated together at the lower part of the temporo-sphenoidal lobe.

If the lesion of any of these centres in the sensory area be unilateral, its fellow in the opposite hemisphere appears to take on the whole function. As far as being aids to the localisation of lesions, it is unfortunate that it is only when there is an identical bilateral lesion that the special sensation involved becomes completely and permanently impaired; therefore unilateral lesions in these areas cannot be recognised by loss of function, and on this account they are apt to remain latent. In destructive lesions of the posterior third of the internal capsule, external to the optic thalamus, hemianæsthesia of the opposite side of the body results.

The portions of the brain in front of the motor area, including the orbital lobe, are not known to be connected with any definite function, except it be that of ideation; and as the one side of the brain is capable of continuing this function after the other side has been destroyed, it is difficult to find any definite symptom indicative of a unilateral destructive lesion in this region.

Lesions of the posterior portion of the third frontal convolution, Broca's region, cause defect in articulate language; when these lesions are destructive they usually produce a distinct psychological disorder, and when they are left-sided aphasia almost always results. When they are unilateral, there is no paralysis of the muscles concerned in articulation, but when destructive lesions in this area are bilateral there is both aphasia and paralysis of the tongue and mouth.

According to Charcot, all paralyses arising from destructive lesions of the motor cortex are permanent, and after a certain time are accompanied by secondary contractions of the paralysed muscles and descending degenerations of the motor tracts. The loss of motion is most marked in those movements which are most independent, the arm being more paralysed than the leg. If a unilateral destructive lesion of the brain involve the whole motor cortex, complete permanent hemiplegia of the opposite side of the body would result. Permanent monoplegia is produced by limited lesions of the cortex of this area. Cortical hemiplegia is not accompanied by defective sensation; whereas hemiplegia due to lesion in or near the corpus striatum is generally associated with a degree of anæsthesia, which, however, is of short duration. As distinguishing features of paralysis arising from intra-cranial lesions, the nutrition and the electrical contractility of the muscles are not affected. They may, however, suffer from disuse, and they may become rigid and contracted through secondary changes or extension of the disease to the spinal cord.

In a case of hemiplegia, the surgeon should first make out if it arises from a cerebral lesion. In the early stage, paralysis of cranial nerves and the presence of mental disturbance will in most cases point to this conclusion. Somewhat later, in the possible absence of these indications, assistance may be derived by noting if the nutrition of the muscles is fairly well preserved, and if they contract to electricity. Secondly, let him ascertain whether the paralysis is permanent, by the muscles tending to assume secondary contractions—from descending degeneration of motor strands—if so, if it be cortical, the lesion will be situated in the motor area of the opposite hemisphere. If the paralysis is confined to certain groups of muscles, the seat of the lesion in a particular motor area can be diagnosed. When right-sided hemiplegia is associated with aphasia, the lesion will include the posterior part of the third frontal convolution.

Irritative cortical motor lesions may give rise to epileptiform convulsions, which begin with a motor aura, and are either general or confined to one half of the body (hemispasm), or to a single muscular group (monospasm). If the lesion is in the motor zone, paralysis of the affected muscles is apt to ensue, and this may be also a guide to the area affected. In general, the lesions capable of provoking epileptiform convulsions are seated in the vicinity of the cortex, and the parts convulsed at the beginning of the attack (protospasm) may be taken as a guide to the lesion. There are, however, instances in which limited convulsions have been present during a considerable period prior to death, and where, judging from these, cortical lesions were expected to be found in the motor area and yet none were discovered; so that it must be admitted that there are a few cases, where functional disorder may induce symptoms similar to those of organic disease.

It will thus be seen that in morbid states of the brain there are two problems to solve, the locality and extent of the part affected, and the nature of the lesion, or, in other words, regional and pathological diagnosis. Regarding the former, the symptoms of cortical lesions, whether they be the result of injury or disease, depend on their situation and on whether they are unilateral or bilateral; so that a knowledge of the physiology of the cerebrum, and especially of the motor centres, becomes a necessity; and if the surgeon is to profit by this, he must know the exact relation in which the various parts of the brain stand to the outside of the head.

Whatever form the pathological lesions assume, they may be divided broadly into two classes, irritative and destructive. The former, among other causes, may be induced by depressed fractures, spicula of bone driven into the brain or its membranes, thickening of the membranes, &c. These may cause twitchings and convulsions of groups of muscles or of one limb, without loss of consciousness; or of the whole of one side, which is usually accompanied by loss of consciousness. Primary paralysis generally indicates a destructive lesion, such as laceration of the brain or infiltration of blood into the brain-tissue.

A few indications may here be given of the relations of the external parts of the head to the convolutions and sulci of the cerebrum. The base of the brain is on a higher level in front than behind. The base of the anterior lobes corresponds to a line drawn across the forehead at the level of the eyebrows. At the side, the base may be roughly indicated by a line drawn from a point (in the adult) half an inch above the external angular process of the frontal bone to the upper part of the external auditory meatus, and from that to the occipital protuberance, the cerebellum lying below that line. To find the fissure of Sylvius (in the adult), draw a line from a point one inch and a quarter behind the external angular process of the frontal to a point three quarters of an inch below the most prominent part of the parietal eminence. The main fissure is seated in the first three-quarters of an inch of this line; the remainder of the line indicates the horizontal limb; while the ascending limb runs vertically upwards from a point two inches behind and slightly above the external angular process. To find the fissure of Rolando, draw two perpendicular lines parallel to one another from the longitudinal fissure—the first to the depression in front of the external auditory meatus, the second to the posterior border of the mastoid process. These lines will give approximately the anterior and posterior limits of the fissure of Rolando, its lower extremity being bounded by the fissure of Sylvius. The point where the anterior line crosses the fissure of Sylvius will be about the anterior inferior extremity; while the posterior superior extremity will correspond to the part where the posterior line meets the longitudinal fissure. The ascending frontal and parietal convolutions bound this fissure.

Scalp wounds are not in themselves dangerous. They heal with ordinary care quite as well as wounds do in any other part of the body, and the reason why they ought to be more carefully examined and treated is, as has been above indicated, on account of their relation to the cranial contents. Such wounds permit of an accurate examination being made of the state of the skull after injury. In all scalp wounds, when the existence of fracture is suspected, a digital examination should be made; if at all possible it is much preferable to the probe. When the wound is large the eye may enable one to diagnose with more precision. When, however, the fracture is not compound, other signs are required for the determination of its existence. There are three external phenomena which are of diagnostic value in cases of supposed fracture of the skull. These are: 1st, infiltration of blood into the tissues in certain directions and places; 2nd, the escape of the cranial contents—blood, cerebro-spinal fluid, and brain-matter; 3rd, symptoms and appearances of brain-lesions complicating the fracture.

A *hæmatoma* may form over a depressed fracture, and prevent its recognition by masking its external physical signs. Again, consequent upon a blow, there may be a rupture of the tissues and an infiltration of them with blood, and, as this condition occasionally assumes the form of an elevated ridge with a hollow in the centre, it might be mistaken for depressed bone. In the former, if there were reason to suspect the existence of a fracture from the symptoms, an antiseptic incision would reveal the true state of affairs. In the latter, firm pressure with the finger on a portion of the elevated border would dispel the swelling at that point, and reduce it to the level of the surrounding scalp.

With *infiltration of blood* into the eyelids, causing discoloration, a differentiation requires to be made between fracture of the base in the frontal region and the ordinary 'black eye.' A pathognomonic distinction cannot be made, as is sometimes stated, by the shade of colour, as the colours in the two cases are sometimes identical. In 'black eye' the eyelids swell first, and the conjunctiva is only afterwards affected, and often not at all. When the blow has been very severe there is great difficulty in separating the eyelids, and often in such cases, as seen a few hours after the injury, there may be no conjunctival ecchymosis. In infiltration from fracture of the orbital plate of the frontal, the eyeball becomes more or less prominent and fixed. The conjunctiva is generally first affected, or it may become so synchronously with the lower eyelid, which assumes a baggy appearance, much like what is seen in œdema, with the additional discoloration. The infiltration may go no further than the lower eyelid, or it may involve the upper eyelid to a slight degree. In cases of wounds of the brow, a discoloured infiltration into the eyelids is very apt to ensue. This always affects the upper eyelids first, then spreads to the lower. Seldom is the conjunctiva infiltrated in such cases, and only so when the pericranium has been separated. But when the fracture runs through the orbital ridge, then the appearances very closely resemble those of 'black eye.' Ecchymosis frequently shows itself behind the ears and extends down the neck in fractures of the base, and when it appears twenty-four or more hours after the injury it is all the more likely to be indicative of this form of fracture. In the pharynx infiltration of blood is likewise occasionally seen in fracture of the base.

Bleeding from the ears, the nose, or the mouth, after an injury to the head, is a common accompaniment of fracture of the base; and when one or other of these follows an injury to the head alone, the source of the bleeding ought to be closely investigated. After an injury to the head, when bleeding takes place from a previously healthy ear in a continuous flow, lasting for an hour or more, in all probability there is fracture of the middle fossa, with rupture of the membrane of the tympanum. If this be followed by a more or less continuous stream of clear fluid, the probability of fractured base is increased; and if these be closely succeeded or accompanied by facial paralysis on the same side, the diagnosis of basal fracture of the middle fossa is positive. Bleeding from the mouth may occur from a fractured base in one of three ways—through the Eustachian tube, through the posterior portion of the roof of the nose, and through a ruptured pharynx, communicating with the fracture—a very uncommon occurrence. The blood in such instances might be swallowed, and escape observation until afterwards vomited. Bleeding from the mouth is by no means such a common accompaniment of fracture of the base as bleeding from the ear, and unless when clearly traceable to one of the abovementioned sources, it is of no value as a diagnostic sign. When it is suspected that it proceeds from a fracture of the base, the pharynx ought to be closely examined. If the hæmorrhage proceeds from a rupture of the mucous membrane of the pharynx, the result of indirect violence, the probability is that there is a fracture of the base of the skull. If there be no rupture of the mucous membrane of the pharynx, then the channel for the blood is limited to the Eustachian tube or the roof of the nose. When the blood comes by way of the Eustachian tube, an examination of the ear on the injured side will reveal a dark, distended, tympanic membrane from the presence of blood within. Blood will likewise trickle through the Eustachian catheter when introduced into the tube.

Hæmorrhage passing into the mouth, from the upper and back part of the nostril, may be considered along with bleeding from the nose. In some cases of fracture of the nasal bones severe bleeding from the nose comes on; but, as a rule, firm pressure exercised by the fingers on the part for five consecutive minutes will arrest it. When the nasal bones have been driven through the cribriform plate of the ethmoid, or when this plate has been otherwise shattered and driven in, and the anterior extremity of the longitudinal sinus has been opened, the bleeding from the nose is venous and much more profuse. On one occasion the writer saw such a case, where the bleeding was not at first very profuse, but this stage was followed by a sudden burst —probably on the removal of a clot—when the venous blood rushed like a torrent from both nostrils for nearly a minute. This is a rare occurrence. The bleeding, however, in shattering of the ethmoid is generally copious, and continues for a considerable period.

Cerebro-spinal fluid may escape through any openings by which blood finds its way from the interior of the skull to the outside. Its escape shows that not only is there a fracture of the skull itself, but also that there is laceration of the brain-membranes. The most frequent point at which this laceration takes place is the tubular prolongation of the membranes surrounding the seventh pair of nerves. It escapes in lesions of the vertex, as well as in those of the base, though in the former the amount is small if the head be kept elevated and the patient at rest. If, on the other hand, the patient be permitted to toss about, to depress the head, or to make violent expiratory efforts, the fluid wells freely away. After an injury to the head, when a clear fluid flows continuously from the ear, especially after a preliminary bleeding, it is almost certain to be cerebro-spinal. The same may be said of the clear fluid that escapes from compound fractures of the skull. When a clear liquid proceeds from the nose or mouth it cannot be satisfactorily traced to a fracture of the skull except by chemical examination, which can be easily carried out. The cerebro-spinal fluid is limpid, contains little or no albumen, and a large quantity of chloride of sodium.

The escape of brain-matter from any of the cavities leaves no doubt as to the nature of the injury—fracture of the skull, with laceration of the brain tissue. Brain-matter frequently escapes from compound fractures in which portions of the bone have been driven into its substance. It has in a few cases escaped from the ear, and also from the nose.

The effects of severe injuries to the head, with or without fracture of the skull, on the *mental condition* is very diverse; the patient may be in a state of profound coma, or in one of complete consciousness, in which a careful examination detects nothing wrong mentally. Though this be true, it is uncommon to find no mental peculiarity in severe head-injuries; and even in cases in which replies are given rightly enough, there is often a cloud hanging over the intelligence, as indicated by the expression of the face, and the tardiness of the answers to the simplest questions. The mental derangement, though at first indicating but slight disturbance, generally increases after the lapse of an interval varying from a few hours to as many days.

There are some cases of fracture of the skull in which no external physical signs exist, but which may be detected from the symptoms to which they give rise. There are, no doubt, many instances of fissured fracture which are free from either symptoms or appearances which would enable the surgeon to pronounce a definite opinion as to their presence. In fracture of the base, besides what has already been mentioned, reliance must be placed upon a careful study of the appearances and phenomena exhibited, all of which are fully entered into under the heading of Skull, Fracture of the.

Patients are brought under the surgeon's notice who are absolutely insensible, and in such cases it is necessary to make at least a proximate diagnosis between pressure on the brain and insensibility induced by drugs or alcohol. No doubt the history in many instances of this kind is amply sufficient to point to a definite cause for the condition; but in many others it is misleading, and in not a few there are—at least in that stage when it is most important that a diagnosis should be made—no items of previous history obtainable. Under such circumstances one requires to rely on the symptoms. In opium-poisoning, as well as in certain cases of traumatic or idiopathic pressure on the brain, the pupils are contracted and fixed; and if reliance were placed on the condition of the pupils alone, the one state might be mistaken for the other. In opium-poisoning, one is almost sure to obtain probable evidence that opium has been taken from the laudanum phial or pill-box found in possession of the individual or in his immediate vicinity. When the patient has taken solid opium there is seldom any distinctive odour from the breath. When laudanum has been drunk, its peculiar odour is usually perceived at an early period in the case, though after the first few hours it is frequently absent. In any case, its absence must not count for much in a diagnostic point of view. When the coma of opium-poisoning has set in, it is accompanied by a slow, irregular, intermitting cardiac and respiratory action, which are not readily mistaken by those who have had experience of them. In such cases there is seldom any injury to the head, as would most likely be the case were the symptoms due to traumatic compression.

Alcoholic coma may be, and very frequently is, accompanied by wounds or bruises on the head. The coma (not mere drunkenness) arising from alcohol may be distinguished from that due to other affections by the fact that, when the patient is left undisturbed for twenty minutes, the pupils are contracted to the size of a pin's head. If an attempt be made to rouse him, by shaking him or pulling his hair, though he still remains quite comatose, his pupils will slowly dilate, until, if the physical stimulation be continued, they become fully dilated. If the patient be then left undisturbed, the pupils remain dilated for a period of variable duration, after which they begin to contract, though at a very slow rate, until they reach their former dimensions. The time taken for the transition from the fully-dilated stage to that of pin-head contraction is from ten to twenty minutes, varying according to the intensity of the coma. In rare cases, where the coma is very intense, the change has been completed in five minutes. In instances in which the patient is not deeply comatose, the dilatation continues for ten minutes, and then the contraction sets in at a very sluggish rate. In persons in whom the alcoholic coma is passing off, and who can be temporarily roused, the dilatation, once effected, continues, or the pupil may become smaller, though it does not attain the same degree of contraction as it formerly did. In some uncommon cases of cerebral compression the contracted pupil will slightly enlarge on stimulation (not fully dilate, as in alcohol), and almost immediately thereafter contract to its former condition. On very rare occasions, when the alcoholic coma is about to have a fatal issue, shortly before death the pupils become widely dilated.

Some have supposed that the state of the patient's temperature yielded a means of diagnosis, but it is not of the slightest value in practice, and, if trusted to, would be sure to mislead. William Macewen.

HEARING, Disorders of. *See* Deafness, Diagnosis of.

HEART, Rupture and Wounds of the.—Rupture of the heart is generally caused by severe compression of the thorax from some heavy body passing over it. It is not infrequently accompanied by rupture of the valves. Death takes place nearly always directly after such an accident, either from the shock to the system, or from blood entering the pericardium freely, and thus interfering with the heart's action.

Wounds of the heart may result either from an external penetrating agent, or from a fractured rib or sternum. The latter, however, does not take place so frequently as the similar accident in the case of the lung, owing to the better protection of the pericardiac cavity in the chest. Its consequences, on the other hand, are much more serious, and for all practical purposes wounds of the heart, whether produced by an external penetrating agent or by fractured bone, may be considered together.

These wounds are generally regarded as necessarily fatal, and though a large proportion of them are no doubt so, yet recovery takes place in about 15 per cent. As in rupture of the heart, death takes place either *immediately* from shock or from blood entering the pericardium and so impeding the contraction of the muscular fibres, or *secondarily* from the after-consequences of the wound. Thus death may take place from continued hæmorrhage either externally or into the surrounding tissue. Or it may take place as a result of the acute pericarditis and myocarditis set up by the injury.

The nature of the wound does not appear materially to affect the mortality, nor does the part of the heart wounded. Thus the average of fatality remains nearly equally distributed amongst punctured, incised, and lacerated wounds, and the same is true whether the right or left ventricle or the right or left auricle be wounded.

The *signs* of a wound of the heart are the fact of a wound existing in its immediate neighbourhood, the occurrence of external hæmorrhage taking place from it, and the signs of internal hæmorrhage, which may take place either into the pericardium or into one of the mediastina. The pulse is small, intermittent, and irregular. There is often considerable pain over the sternum, and much dyspnœa, though these are not constant. The dyspnœa does not come on immediately, but is generally a later sign in those who live sufficiently long. Auscultation may reveal a friction sound if the amount of blood in the pericardium be small, but more frequently nothing is audible, the heart-sounds being muffled by the surrounding blood.

Treatment.—Rest to the injured part, so far as Nature herself permits it, is the most important element in the treatment of these cases. This is necessary for the prevention of hæmorrhage, both internal and external. The patient should lie absolutely still in the position most easy to him, no food or stimulant be allowed for the first twenty-four hours, and after that only the very smallest quantity of fluid nourishment. Half a pint of milk, with a very small allowance of ice to suck, is generally all that is required for three or four days after the injury. Small venesections may be employed with advantage, during the first few days, to diminish the tendency to hæmorrhage and to increase the coagulability of the blood, if they can be done without too much disturbing the patient. Cold may be usefully applied to the part, and it is said that belladonna and digitalis administered internally have also a certain value. Much trust, however, cannot be given to these drugs, and it is probable that rest, starvation, and small bleedings have a much more powerful influence for good than any drug. H. G. Howse.

HECTIC FEVER is the systemic expression of a continuous wasting or exhausting process, which in surgical experience is so frequently suppurative that the common term 'suppurative fever,' though too restrictive, is hardly a misnomer.

Pathology. — Unlike traumatic and many other fevers, hectic is not produced by absorption into the blood of any morbid matters. It may be due to a pre-existent state of over-action and excitement, sufficiently intense and prolonged to have greatly depressed the vital powers; to defect of the nutrient powers, preventing due repair of the blood; or to continued subtraction from that blood of its protein elements, through some disordered excretion, or by means of suppuration. Thus, acute exhaustion, as from nervous shock or hæmorrhage, is expressed by prostration, chronic exhaustion by hectic. Therefore the names of all the diseases that frequently give rise to this fever may be omitted here, if it be taken that all subacute or chronic maladies, attended by pain, sleeplessness, inedia, impairment of the assimilative functions, loss by the kidneys of albumen or sugar, &c., are generally accompanied or closely followed by hectic. But the most frequent and common cause is prolonged suppuration; therefore, as strumous and tuberculous diseases are those which most frequently induce such discharges, and as persons of such diatheses are usually feeble—in other words have little recuperative power—so do we find hectic very surely developed in strumous and tuberculous affections accompanied by pus-formation.

Symptoms.—Since the morbid action which induces hectic operates little by little throughout a considerable period, so must the advent of that fever be very gradual, its first onset very slightly marked. Probably a sense of fatigue and weakness on first waking, a distaste for the morning meal, a rather rapid and small pulse, are the first signs. Afterwards, a slight loss of flesh will be noticeable, and the pulse becomes irritable; that is to say, while the patient is at rest its rapidity is normal or nearly so, but any excitement or exertion raises it by ten or twenty beats. The skin is somewhat dry and hot; this is at first only observed in the evening. Afterwards it is dry throughout the day, the evening, however, still keeping its pre-eminence. Many patients are at that time chilly, uncomfortable, and often thirsty; the tongue is either white, slightly furred, and feels sticky in the mouth, or else is unnaturally red and irritable-looking. The rest, at all events during the early part of the night, is unbroken; but awakening takes place early, and the patient finds his night-dress and the bed-clothes wet with perspiration.

By this time the febrile state is fairly established; the emaciation has become pretty strongly marked; the face, frequently pale and transparent-looking, flushes very easily, or there is a permanent, sharply-defined flush about the cheeks, the rest being pallid; the redness of the lips is often strongly marked, the eyes are bright, the sclerotic brilliantly white. Morning fatigue and languor, with evening irritability and excitement, correspond with the thermograph, which shows a normal, or even subnormal, temperature in the early hours, and a rapid rise after 2 p.m. Such is the usual and general course, but occasionally variations occur, probably produced by some condition of the digestive system. At this time the tongue is usually very clean, presenting a lighter or more pink-like red than is normal. The appetite is very variable and capricious; sometimes the patient eats well, at other times but little; requires much tempting, and often, after selecting certain viands for his next meal, turns from them, when set before him, with disgust. The action of the bowels is likewise irregular, the stools often loose, though not large in amount; at other times constipated. The urine is pale, rather abundant, and deposits much lithate of ammonia; there is, too, some excess of sulphuric acid and chloride of sodium.

If the exhaustive process and, therefore, the fever still continues, the last stages are marked by obstinate diarrhœa and violent night-sweating, called 'colliquative,' while in the day the excessive dryness of the skin renders it rough and furfuraceous. Emaciation is extreme. The joints of the limbs come to be larger than the mid part of each segment. On the trunk the bony processes become sharp and prominent; the skin over them, tightly stretched, is especially liable to develop bed-sores. The pulse is very small and quick, from 120 upwards; the temperature, while still subject to periodic elevations, has a tendency in the intervals to fall below normal. In this stage certain viscera may enlarge—the liver more particularly, and the spleen—while the urine exhibits casts called hyaline. If these conditions arise, the skin assumes an earthy hue, hardly icteroid, even though the liver be much involved. These symptoms mark lardaceous disease, which is chiefly, if not entirely, associated with prolonged suppuration. Throughout, the mind remains clear, and, until death is very near, free from delirium, which is often absent altogether; although in all stages, save the earliest, the patient is not infrequently troubled by unpleasant, even frightful, dreams, from which he awakes somewhat confused.

Treatment.—The chief, most certain and rapid cure of hectic is removal of its cause, either by healing a discharging sore or cavity, or by ablation of diseased parts. The surgeon, though he may often have witnessed such an effect, is always charmed to see how, after a successful operation, his patient rallies from even severe hectic. The writer has more than once witnessed this result when lardaceous disease was already somewhat advanced.

The draining, and if possible, healing of an abscess, the removal of sequestra, though perhaps large and deep, should never be neglected. More important operations, especially such as mutilate to a greater or smaller extent, viz. excision of a joint or amputation, though never to be inconsiderately undertaken, must not be evaded until too late. In many cases the position of the disease permits of no such measures, and of these there are two sorts: such as may get well if life can be prolonged and strength maintained, and such as must prove, in an uncertain period, fatal. The treatment, though the same in both, is evidently more important in the former case. The surgeon's object must be to maintain strength, and so lessen fever. Food should be of the most nutritious forms, administered frequently and in small quantities, nor should it be at any time intermitted for any long period. Stimulants, in moderate quantities, are generally necessary. To diminish the fever, quinine in doses of from 3 to 10 grains, may be given an hour before the periodic rise. Kairine is in many cases useful. Sulphuric acid and iron are also valuable. If these check the fever they will also diminish the night-sweats, and for this latter purpose belladonna or its alkaloid is often effectual, as also is sponging the surface with hot vinegar and water. When diarrhœa supervenes, such astringents as kino or sulphuric acid, with spirits of chloroform, cardamoms, and tincture of opium, may be administered. The latter drug may only be used in small doses, as it augments perspiration. By such means we may, in the former class of case above-mentioned, prolong life until the local disease heals, or at all events we can carry out our duty of maintaining existence as long as possible.

R. Barwell.

HEMERALOPIA.—This term, like nyctalopia, has been, and still is, used in two opposite and contradictory senses. Some writers employ it to denote *day*-blindness, and others *night*-blindness. Most modern authors use it in the latter sense; all older writers in the former sense, and in contradistinction to nyctalopia. As Galen, in his Hippocratic lexicon, defines 'nyctalopes' to be those who are blind at night, it is certain that the original meaning of the word hemeralopia was day-*blindness*, and, so far as the term is admissible into modern nomenclature, it should continue to be used in this sense. Day-blindness usually assumes the form of photophobia, or dread of light, and is commonly dependent upon inflammation of the cornea, sclerotic, or iris. See *Nyctalopia*, under Amblyopia.

J. Tweedy.

HEMIANOPSIA denotes an absence of one-half of the visual field. It is also called hemiopia. *See* Amblyopia; Perimetry.

HEMIOPIA. *See* Hemianopsia.

HERNIA of the BLADDER. *See* Cystocele.

HERNIA CEREBRI. *See* Brain, Hernia of the.

HERNIA, Inflamed.—In the form of rupture so named, there is acute or subacute inflammation of the interior of the hernial sac, and of its contents. The condition, indeed, is essentially that of acute peritonitis, limited to the parts concerned in the protrusion. The following are among the chief causes of this condition:—The pressure of an ill-fitting truss, blows upon the part, violent exercise, the arrest of a foreign body in the herniated loop, severe diarrhœa. The condition is much more common in irreducible than in reducible herniæ, and in small ruptures than in large. It is especially apt to occur in herniæ containing omentum. Omentum appears to be more readily inflamed than gut, and its lack of elasticity renders it less able to withstand the effects of violence.

The commonest seat of an inflamed hernia is a small irreducible femoral epiplocele. On examination, the inflamed parts are found to be red and œdematous. The sac will probably contain no fluid, but on the surface of the inflamed serous membrane will be many flakes of lymph. In some cases, however, there is much serous fluid in the sac, and but little lymph upon the surface of the membrane. The condition may pass on to suppuration, and the sac may be converted into an abscess-cavity. As a rule the mischief ends in resolution, and the involved gut or omentum, if not already irreducible, is found to have become fixed to the sac by unyielding adhesions.

The *symptoms* in this form of hernia are tolerably pronounced. The tumour is irreducible, is tense, hard, and firm, is the seat of much pain, and is extremely tender. If situated in the groin, the pain is increased by movement of the limb. The skin over the swelling is hot, red, and œdematous. The tumour is most probably dull on percussion, but still retains an impulse on coughing. There is some malaise, and a varying degree of fever. There will probably be nausea and possibly vomiting, but in any case the latter symptom will be slight. There may be constipation, but it will, if present, not be absolute. There is no marked abdominal pain, and no constitutional depression.

As a rule, the case ends favourably in three or four days, but in exceptional instances the inflammation may spread to the general peritoneal membrane, or the gut may become acutely inflamed and even gangrenous, and extensive suppuration may appear in the sac.

In the *treatment* of the case, absolute rest in bed must first be insisted on. The parts should be so adjusted by posture as to relax as far as possible the tissues about the hernia. An ice-bag should be applied to the part, or a proper degree of cold may be maintained by Leiter's tubes. Opium should be given, and the patient placed upon a scanty diet of fluid nourishment only.

If any of the complications arise to which reference has been made, they must be treated in the usual way.

Frederick Treves.

HERNIA, Irreducible, is a morbid condition of a hernia in which the contents of the sac cannot be completely replaced within the abdomen. This form may include intestine or omentum, alone or both together. This condition does not give rise to symptoms of strangulation or of obstruction, although it frequently causes increased dyspeptic flatulence. It is due occasionally to non-recognition of the lesion, more frequently to neglect on the patient's part to procure a well-fitting truss.

Irreducibility may depend upon causes situated—(*a*) outside the sac, due to the fibrous structures of the abdominal walls; (*b*) in the sac itself, as seen in cases where the neck is much narrowed or unduly thickened; or (*c*) in the very large majority of instances it is referable to altered conditions of the sac-contents. These are the presence of fluid, more or less in amount, in the sac, so that no well-directed pressure by taxis can be exerted upon the solid contents; adhesions between the omentum or the intestine and the sac; fibrous adhesions uniting contiguous portions of the omentum, so that it cannot be unravelled; adhesion of a coil of intestine; adhesions between omentum and intestine; accumulation of fat, or fibroid changes taking place in the omentum; hypertrophy of the mesentery; sudden descent of a large amount of intestine or omentum, or both together; fibrous bands passing across the sac; and, lastly, the anatomical peculiarities of the extruded viscera, which either have no sac at all, or only an incomplete one, as in hernia of the cæcum, sigmoid flexure, bladder, &c.

Irreducible herniæ are most commonly met with in the inguinal, femoral, and umbilical varieties.

In the inguinal variety of hernia, 2·8 per cent. are irreducible in males, and in females 3·1 per cent. In the femoral variety, the protrusion is irreducible in males to the extent of 15·5 per cent., and in females to that of 25·2 per cent. In both varieties of hernia, the right side is that on which it is most commonly irreducible. In females, this holds good positively and relatively; in males, hernia of the left side shows, in later life, a slightly increased tendency to become irreducible.

The contents of irreducible herniæ are usually omentum, the intestine being rarely irreducible; so that irreducible intestine amounts in inguinal herniæ to only 1·6 per cent., and in femoral herniæ to ·3 per cent. of all cases of irreducible hernia. This condition of hernia is liable to become inflamed, incarcerated, or strangulated; and cases have also been described in which the irreducible intestine has been ruptured by blows and falls.

The *symptoms* of irreducible hernia are those referable to ruptures generally, only largely increased. Beyond these symptoms are those of colic, constipation, and inconvenience from the size and weight of the hernia. There is no limit to the size which irreducible herniæ may attain, varying as they do from that of a small walnut to one involving a large part of the intestines and omentum.

As irreducible hernia leads, apart from local inconvenience and dyspepsia, to more serious morbid conditions, its treatment should be carefully watched. In all cases instrumental support must be given, not only to procure reduction of the mass if possible, but also to prevent increase of the hernia and its consequent dangers. In the majority of cases, complete reduction may be looked for by the application of well-fitting trusses, assisted by the cordial co-operation of the patients. By the constant pressure of hollow-padded trusses, gradual absorption of the omental fat and adhesions is effected, so that after wearing instruments for a longer or shorter time the mass becomes so diminished in bulk that it can be easily reduced. This reduction may take place gradually or suddenly.

If the presence of fluid in the sac be the cause of irreducibility, this may be evacuated by tapping, when the contents are in some cases capable of reduction.

Irreducible omentum may be removed by operation, and at the same time the sac should be excised. This operation is not without danger, for several fatal results have been recorded.

Irreducible intestine should be treated by suspensory bags, or by hollow-padded trusses having rim plates, the interval being filled in with chamois leather, so as to increase their depth without increasing their weight.

Herniæ of the bladder or large intestine, which, by the nature of their anatomical relations, are frequently irreducible, must be treated by palliative measures of support, by strong suspensory bags, or hollow-padded trusses with rim plates. *See* TRUSSES.

The plan of attempting reduction of old irreducible hernia by long confinement to bed and restricted diet, so as to lessen the amount of fat in the omentum or mesentery, has been recommended. The application of ice is sometimes followed by reduction, the result as much of the steady, persistent pressure of the ice as of the physiological effects of cold.

JOHN LANGTON.

HERNIA, Obstructed or Incarcerated. In this form of rupture there is a hindrance to the return of the bowel into the abdomen, and an obstacle to the passage of its contents. The loop of intestine in the hernia becomes blocked up with fæcal matter, and a certain amount of obstruction is thus produced. This blocking is brought about either by a slight increase in the degree of constriction to which the loop is subjected, or by a sluggish movement of the intestinal contents, or by an increase in the quantity of those contents and in their consistence. The condition is most usually seen in cases where a part of the colon is involved in the rupture, and is comparatively rare in forms of hernia other than the umbilical. A loop of small intestine can scarcely be the seat of obstruction in the present sense of the term. The contents of that bowel are fluid, and it is hardly intelligible how a loop of small intestine can become blocked by gas or fluid. The contents of the lower ileum have often the consistence of soft fæces, and a hernia containing a portion of this segment of the bowel may be the seat of an incarceration. The so-called obstructed herniæ of small intestine would be more properly classed as herniæ the seat of a slight degree of strangulation.

The tumour, in cases of obstructed or incarcerated hernia, is increased in size, is tense, is tympanitic in some cases, and dull and doughy to the touch in others. It is seldom markedly tender, although it may be the seat of much pain. Often the swelling can be partially emptied by pressure, or its outline may be altered by the same means. Unlike the tumour in strangulation, there is an impulse on coughing, and although the mass is irreducible, it is not so hard and unyielding as it is in the more serious condition.

The constitutional symptoms are those of severe constipation. There is nausea, and possibly vomiting. The vomiting is never alarming, is never feculent, and is often quite insignificant. There is constipation, but it is not usually absolute, and flatus is often passed. There is some distension of the abdomen, but no grave abdominal pain. The tongue is coated, the appetite is lost; the pulse may be enfeebled.

There is, however, no marked constitutional depression, as in strangulation, and indeed the condition present could only be confused with strangulation in the old and cachectic.

It will generally be found that the patient is liable to constipation; that he has been constipated for some time before the hernia has become obstructed; or that he has been the subject of flatulent dyspepsia, or of some kindred intestinal disturbance.

The *treatment* is simple. The patient must lie in bed. An ice-bag may be applied to the tumour, or the swelling may be emptied as far as possible by manipulation. If there be much pain, opium may be given in small doses. The diet should be scanty, and composed of small quantities of fluid nourishment only. An enema should be at once administered, and repeated several times if necessary. As soon as the local and general symptoms are less urgently marked, a dose of castor oil may be given.

FREDERICK TREVES.

HERNIA, The Radical Cure of.—In the Jacksonian prize essay of the Royal College of Surgeons of 1862, the writer was the first to demonstrate by the results of sixty cases of inguinal hernia the necessity, in the operation for radical cure, of closing up not only the neck and cavity of the sac, but also the deep ring, the sides of the inguinal canal, and the pillars of the superficial ring; and he accomplished these objects, in cases of reducible hernia, by the use of one common ligature applied in a peculiar way. Since that date he has used in 240 cases a stout silvered wire ligature, applied subcutaneously as described in the following pages, with the results of about 20 per cent. of failures and only two deaths. Two hundred of these cases were operated upon successively without a single death.

Since the introduction of the more complete application of the antiseptic method, rendering the dangers of operation less and the success more certain, the author has applied his operation, modified as required, to cases of irreducible hernia, and also to strangulated herniæ after herniotomy. In such cases the sac must necessarily be opened to obtain access to its contents, the removal of a portion of omentum is frequently required, and the risks of the operation are considerably increased.

In his address on Surgery to the British Medical Association at King's College in 1873, the writer advocated the ligature of the deep hernial aperture and the sac at and during the operation for strangulated hernia, after the bowel (not too much damaged) had been returned and a portion of the omentum (if necessary) entirely removed. On that occasion a patient was exhibited upon whom this proceeding had been successfully adopted. Since that time he has operated under spray in thirty cases of inguinal hernia with three deaths, and in eleven cases of strangulated inguinal hernia with one death. In some of these the sac was tied, twisted, and wired or tied across in several places, but in the majority the sac was entirely removed after ligature of its neck. In many, a stout piece of carbolised kangaroo- or ox-tendon has been employed instead of wire, but applied in the same way as had been done in his earlier attempts at the radical cure with ligature-thread and compress.

A similar operation has been performed by him in twenty cases of crural hernia, fourteen of which were cases of strangulation and three of irreducible hernia, with one death and one failure.

Some of the modern operators for the radical cure of inguinal hernia have devoted their attention chiefly to the closure of the pillars of the superficial ring, either by applying subcutaneously catgut, gold, or silver sutures, closing the skin over them, and leaving them in permanently, or for as long a period as the tissues will retain them. Some have, to all appearance, fancied that thereby they have effected an improvement and an important modification in the direction of simplicity upon the writer's method.

Mr. Spanton has proposed and practised a method of closing the canal in reducible cases, which is in its way very ingenious—viz. by the use of an instrument like a corkscrew, applied upon the pillars over and around the fore-finger invaginated into the canal, and left there until union has taken place. Others have, with greater effect, directed attention chiefly to securing the neck of the sac at the internal ring by what is called the *open method.* For this purpose an incision along the whole length of the canal down to the sac is practised, usually under the carbolic spray. Then the sac is opened and its neck is carefully separated from the spermatic cord and tied with catgut. At the same time some surgeons remove the sac altogether; others are content with twisting and stitching it up. In irreducible cases the sac is opened, the adhesions separated, and the omentum, if necessary, removed. The remaining steps of the operation vary with the individual operator, nor would it be within the scope of this article to do more than mention the names of the surgeons who have lately been working for the improvement of this department of surgery.

Professor Annandale of Edinburgh, Professor Stokes of Dublin, and Mr. Mitchell Banks of Liverpool have done good work in this direction. These surgeons stitch up the pillars of the superficial opening either with catgut, wire, or silk cord. In some of his later cases Mr. Banks has included the conjoined tendon, thereby approaching nearer to what the author considers to be an essential step towards the production of a radical closure of the canal. A similar plan has been followed by Sir William MacCormac. This kind of operation has been done abroad, according to Tillanus of Amsterdam, in numerous cases, and also by M. Reverdin of Geneva.

It is very difficult, from the nature of the case, to obtain reliable statistics of the deaths following the open method of operation. Still more difficult is it to get at the real results as to a radical cure. M. Tillanus gives 11 per cent. of deaths as the result in the numerous cases he has collected. The death-results of the recent operations by the open method are very difficult to obtain. Some of the cases operated on by the writer have been very large, and so have some published by Annandale, Banks, and others. The size of the rupture does not seem to influence the mortality as much as might be supposed.

We may conclude, however, that 11 to 12 per cent. of deaths even is too great a mortality to render the open method attractive. No doubt, in correspondence with all analogy, the mortality will decrease as surgeons become more skilful and dexterous in manipulation, and the number of cases multiplies. We may also conclude, from ample experience, that too much reliance cannot safely be placed upon ensuring the complete effect of any kind of antiseptic dressings. The region to which they are applied is a very difficult one upon which to fix and retain the dressings free from septic infection, and a limited size of the wound is of considerable importance from this point of view.

Selection of Cases and Modes of Operation.—The experience of nearly 400 cases of operation for hernia (from April 1858 to February 1885) has shown the writer that hernial cases differ so much from each other—even those classed necessarily under the same names—that modifications and variations of the operations for the radical cure are absolutely necessary to accomplish fully the purposes of the surgeon. Thus: 1. For simple *reducible inguinal hernia*, which resists the curative effects of careful and continued truss-pressure, the subcutaneous method of applying a thick silver wire to the sides of the canal, rings, and sac is most suitable, both because of its successful results—viz. 240 selected cases of operation, 9 of which were double, and 11 second operations, with (as far as could be followed) 40 failures (18 to 20 per cent.); and because of its safety, only 2 deaths having occurred, 1 from tetanus and 1 from peritonitis, set up independently of the operation. Two hundred consecutive operations by this method, without special antiseptic precautions, were performed by the author without a single death. A modification of this (used in young children), consisting in the employment of two pins instead of wire, has been used in 48 cases more, with 7 failures and 2 deaths, 1 from erysipelas and 1 from peritonitis. For some years these were exclusively the hernia operations practised by the writer, and no cases were operated on except those of reducible and uncomplicated hernia.

2. Cases of *reducible inguinal hernia* in which the omentum was troublesome, slipping down under the truss and dilating the canal progressively. In these the omentum and sac have been altogether removed under spray and antiseptic precautions, and wire, tendon, or catgut has been used for ligature. This operation has been performed in 16 cases, of which 1 died, all tho rest being successful.

3. Cases of *irreducible inguinal hernia* incarcerated by adhesions or changes in the omentum, in which catgut or tendon has been used for ligature, the adhesions detached, and the sac and omentum removed. Of these there have been 14 cases, with 2 deaths, but no failures.

4. Cases of *strangulated inguinal hernia* resisting taxis under anæsthetics, in which, under spray, and after the ordinary operation for strangulation, the sac has been tied close up to the deep ring and removed, with or without a portion of omentum, and the inguinal canal closed with wire, catgut, or tendon. Of these there have been 11 cases operated on by the writer, with 1 failure and 1 death from peritonitis, the latter resulting from the injury inflicted on the bowel by the strangulation and not from the operation.

In reviewing the foregoing it will be seen that the mortality increases clearly with the severity of the case, and, therefore, of the operation; and that the result has depended, to a considerable degree, upon the extent of interference with the integrity of the parts concerned in the operation. The nature of the means adopted in the operation, the method of it, and the careful selection of cases fit for the operation, are shown to have some influence by the result of seventeen reducible, but otherwise unselected cases, operated on by the writer's earlier and abandoned method with common ligature-twine and boxwood compress, in the course of which suppuration, as a rule, occurred—viz. 17 cases with 8 failures and 1 death; and also in the pin method, now rarely used, 48 cases (1 double) with 7 failures and 2 deaths. Something considerable, too, must be allowed for improved manipulation and dexterity in operating in the later cases, and for matured judgment and experience—as in all other operations.

Writer's Percentage of Successful Cases. It comes out clearly that, in this operation, the greater number of failures declare themselves during the first two years after the operation. If the operation is not properly done, or from some other cause, the return is evident when the patient removes his truss or ceases to wear it. Consequently, in estimating results, the writer has left out all cases which have not been cured for two years. He has been able to follow (out of a total of 339 cases of the variously modified subcutaneous operation) 96 cases, all of *more than two years'* duration after operation. The longest was twenty-five years after operation, and this was a case of very large rupture, with no truss worn after. Twenty have been examined more than ten years afterwards, and the rest at various periods above two years. In 59 cases there has been a return of the rupture to a greater or less extent, usually before the end of two years. In 152 other cases the patients are known to be cured up to and below two years after operation. The proportion of successful cases in 339 instances of the subcutaneous operation is calculated at from 73 to 82 per cent.

The number of deaths in the 339 cases was five, one of which was from tetanus, and one from causes quite unconnected with the operation. The other deaths were from erysipelas, peritonitis, and pyæmia. Two hundred and twenty subcutaneous wire operations were consecutively performed without a *single* death, and in 240 wire operations there were only two deaths.

OPERATIONS FOR THE RADICAL CURE OF INGUINAL HERNIA.—The instruments used by the writer for these operations are a small scalpel or tenotomy knife, and a stout curved semicircular needle on a strong handle. The concave surface of the needle should be flat, the other rounded. The point must be sharp, but the tapering shoulders of it not sharp enough to cut, but only to split the tissues. Both should be steeped in carbolic lotion (1–20) and plentifully oiled with carbolic oil (1–5). In most of the writer's operations thick copper-wire, silvered, one foot and a half long, has been used to close the canal and rings—wire thick enough not to cut through the compressed structures too quickly, and not so thick as to be inflexible; each end should be bent into a well-made hook. Latterly, however, he has used a stout piece of kangaroo- or ox-tendon, well soaked in carbolic oil for a month at least before. It is applied exactly in the same manner as the wire, but tied in a surgeon's knot instead of the twist of the wire. He cannot yet speak positively as to the respective advantages of these two methods. The tendon is better than catgut, as it is more pliable and does not untwist. It possesses the undoubted advantage, like prepared catgut, of not requiring removal subsequently, and of maintaining its hold of the closed structures until the adhesions and fibrinous effusion set up to replace it are permanent and resisting. The wire sets up more solid effusion and granulation in the track of its passage, and keeps open a straight drain for the escape of any fluid effusion, but it necessitates removal after a week or ten days, and frequently a second administration of anæsthetics.

The patient being anæsthetised and laid on his back, with the shoulders raised and knees drawn up to relax the groin structures, and the pubes and genitals shaved and well washed with a 1–20 carbolic solution, a vertical incision about three-fourths of an inch long is made through all the integumentary structures about one inch below the pubic spine. Sometimes, in old cases which have worn a truss, the superficial external pudic vessels require ligatures at both ends after being divided. The edges of the cut are then detached from the deeper tissues with the handle of the knife; the forefinger purified and dipped in carbolised oil, is passed through the cut, and made to invaginate the deeper coverings and the sac (if scrotal) as far up the canal as the deep ring or hernial opening. Then, by hooking forward the finger, the thickish muscular border of the internal oblique muscle is raised, and the finger is pressed inwards so as to pass behind the edge of the conjoined tendon, raising it well forward. The curved needle is then passed along the concavity of the hand till its point is felt at the tip of the finger, when it is pushed through the resisting structures until its point is seen to raise the yielding skin of the groin at the level of the deep ring. This skin is now drawn inwards towards the median line, and the needle pushed through it. Then the hook of the wire (if wire be used), or the end of the ligature (if tendon or catgut be used), is passed through the eye of the needle and drawn down through both the groin and the scrotal punctures and detached. The invaginating forefinger is then shifted outwards and placed behind the centre of Poupart's ligament, pushing inwards the cord, so as to feel distinctly the groove formed by Poupart's ligament. The latter is then lifted well forwards and kept away from the iliac vessels, which lie directly behind it. The needle is again passed along the concavity of the finger to its point and through Poupart's ligament. When seen to raise the skin, the latter is drawn outwards until the needle-point can be passed through the same aperture as in the previous stage. The needle is then withdrawn, carrying the other end of the ligature or wire through the scrotal puncture. If wire be used, a loop must be left protruding through the groin puncture.

The deep coverings of the cord below the superficial ring are next pinched up by the finger and thumb—and with them the sac of the hernia, if present—at the scrotal opening. The spermatic duct is to be here carefully felt and distinguished, and the needle passed in front of it at one side of the scrotal puncture and out at the other; one end of the ligature or wire is then passed through its eye, drawn back with it, and detached. If wire is used there will now be a loop above at the groin puncture, and two loose ends below at the scrotal incision. The wire must then be pulled upon so as to be straightened out between the loop and the ends, where two twists are to be made and the loop drawn up so as to invaginate and compress all the tissues; the wire is then finally twisted down at the loop end into the groin puncture. With the tendon ligature all that is needed is to tie firmly together the two ends protruding through the scrotal incision in a true surgeon's knot, and to cut off the ends within the incision, stitch up the upper part of the incision if it gapes, and put a few horse-hairs for drainage into the lower part. If wire is used, the ends are bent upwards to the loop, passed through it, and fastened by a single bend, the ends being cut off short. The patient is then put to bed in the sitting posture, with the knees drawn up over a bolster, and fed on milk and beef-tea for a few days.

It will be observed that the steps of the operation are essentially the same whether wire or tendon be used as the retaining medium. the nature of the material employed requiring a little modification of the process. The wire may be withdrawn after a week, ten days, or a fortnight, according to the amount of action set up. Usually there is very little discharge, and the wire comes away with little trouble. The two ends are untwisted and stretched straight, and the loop pulled upon. The two parts of the wire lie usually in the same track, having slowly ulcerated through the tissues and left granulations behind them, which close up firmly by a deep cicatrix the compressed and twisted tissues. The tendon remains in the tissues, and holds them together until the solid effusion which ensues absorbs and replaces the ligature. Upon the perfection of this process depends the permanency of the cure.

By this operation the valvular arrangement of the sides of the normal inguinal canal is restored by the union of the conjoined tendon with the edge of the deep ring, the internal pillar of the superficial ring, and with the fascia transversalis and deeper fibres of Poupart's ligament. This union occurs, if the operation be well managed, close up to the deep ring, and involves its structures also. The obliquely placed ligature embraces both the invaginated sac, the deep ring, the canal, and the superficial ring. The inner limit of the ligature is the edge of the sheath of the rectus, the outer limit is Poupart's ligament. In the numerous operations now performed no trouble has ever been experienced with the epigastric artery. It yields easily to pressure, and cannot be punctured. If included in the ligature, it becomes obliterated without further trouble. The iliac vessels are avoided by lifting up Poupart's ligament well on the finger, and by keeping the needle well in front of the finger. The writer has never had trouble of any kind from this source in all his experience, now very considerable.

Modifications of the Operation.—In cases in which it is thought desirable to open and remove the sac, with or without removal of the omentum, the scrotal incision is carried upwards as far as the superficial abdominal ring, and through all the intervening structures down to the sac itself. The sac is carefully looked for and drawn out of the wound, great care being taken in detaching it from the spermatic duct, which is closely connected with and often totally invested by it. The fingers, forceps, and the handle of the knife are the safest instruments to employ. If it be necessary to use the point of the knife, the incision should be always vertical—i.e. in the direction of the duct, which it is desirable to avoid, and never across it. The sac should be gradually enucleated, and its fundus detached from the tunica vaginalis and drawn out. An opening to admit the finger should then be made, and any omentum which may lie in the sac is thus brought into view. The fundus of the sac is then lifted up and held at right angles to the trunk, while the finger of the surgeon feels carefully for the deep abdominal opening. The sac is then isolated as far up as this point, which is easily done through the dilated superficial ring. If difficulty be experienced, the upper fibres of this ring—i.e. the *intercolumnar*—are to be cut to a limited, but sufficient extent, to allow of a complete investment of the neck of the sac with the ligature. If there be a process of the omentum which it is desirable to remove, this should be first dealt with. All adhesions to the sac, whether of omentum or bowel, which can be easily separated, should be first detached; then the omentum, held firmly by the assistant, should be spread out and examined. A small curved suture-needle, armed with the thinnest catgut, should be passed under the vessels which are seen in the omentum separately, and these should be tied, the ends of the catgut being cut close. Then, the deeper part of the omentum being still held firmly, the portion of it which is beyond the ligatures should be cut off with the scissors. Any oozing points should be tied carefully with the catgut, and the part exposed to the air to see if there be more oozing. The omentum is then allowed to return into the abdominal cavity.

The sac is next dealt with. The forefinger being passed through it to the deep ring, the neck of the sac is twisted round firmly for two complete turns. The handled hernia-needle before described is armed with thick, stout, prepared catgut or tendon, and is passed across the twisted neck of the sac at the point of the finger, close up to the deep ring, a double ligature being left on the withdrawal of the needle. The loop is cut and the four ends tied, two and two, in a firm surgeon's knot, and cut off close. Care must be taken here that the spermatic duct behind the sac is not included in the ligature or injured in any way.

Lastly, the tendinous sides of the inguinal canal are to be secured by wire or tendon in the way before described—viz. through the conjoined tendon close to the edge of the rectus muscle on the inner side, and through the centre of Poupart's ligament on the outer side, the two ends of the ligature, tendon, or wire being brought down into and through the scrotal puncture. There being no sac left in the scrotum, the needle must now be carried across in front of the spermatic cord and closely embracing it, through the fibres implanted into the pubic spine on the one hand and the internal pillar of the superficial ring close to the pubic crest on the other, and the end of the ligature or wire be drawn across, leaving the cord easily movable behind the ligature. If tendon or thick catgut is used for ligature, it must be tied firmly, so as to be quite tight. A surgeon's double knot should always be used. If wire is used, its ends must be twisted as before described, and the loop above drawn upon so as to close up all the tissues involved, and secured as already mentioned. Finally, a drainage-tube should be placed along the cord close up to the ligature, and the scrotal wound closed by sutures.

For the better safeguarding of the patient, the writer is strongly of opinion that the strictest form of antiseptic dressing and treatment should be followed out. He employs Lister's spray method as the most sure and convenient.

In this operation the ends of the wires or ligature are crossed like a bootlace. The superficial ring and canal are thus secured along their whole extent, together with the deep hernial opening. The sac is tied close up to the deep ring, and the possibility of its becoming patulous and again admitting bowel or omentum is removed by its adhesion to the oblique muscles and aponeurosis. The ligature and removal of the omentum, in the cases requiring it, add a still further impediment to a return of the rupture by the stump becoming adherent to the deep hernial opening. There is thus formed, in large and severe cases, a triple barrier against a return of the rupture.

In cases of direct hernia this laced arrangement of the ligature must be carefully carried out, the needle being carried through the tissues close to the border of the rectus muscle, so as to include the margins of the opening in the conjoined tendon. In such cases, there is found not uncommonly an awkward position of the spermatic cord in relation to the sac. It may be found in front of the sac instead of being outside it. It has also been in several cases found to be separated into two parts, one containing the spermatic duct and the other the spermatic vessels and nerves. In all these cases it should be carefully looked for and isolated before lifting out the sac.

In congenital hernia, the fundus of the sac may be left attached to the testicle, and sewn up with fine catgut to form a *tunica vaginalis*, the intermediate portion up to the deep ring being removed.

The writer considers it advisable, in all cases where an elongated piece of omentum is habitually in the sac, to open the latter and to remove the omentum and sac. Nothing is more calculated to dilate the openings than a piece of omentum forced down by abdominal muscular pressure. Experience has shown that in such cases, uncomplicated and in healthy subjects, the ligature and removal of the sac and process of omentum under the spray is a safe enough proceeding; while the result is a more resisting impediment to the return of the hernia.

A still more difficult complication is found in an *imperfect* or *non-descent of the testicle.* This is usually associated with, or followed by, a hernia of the congenital kind, with an open funicular process. The hernial contents are in close contact with the testicle, often passing in front of and below that gland, so as to resemble a hydrocele. This resemblance may be further increased by the presence of fluid from the peritoneal cavity in the sac of the hernia. In these cases the process of peritoneum is usually drawn down by the gubernacular fibres which are attached to it, so as to *precede* the testicle, which is kept back by adhesions in the inguinal canal or abdominal cavity. If, under such circumstances, strangulation takes place or the testicle becomes inflamed, the case is obscured and complicated in a very dangerous manner. In several cases of this kind in young adults the writer has successfully dealt, by one operation, with both the undescended testicle and the hernia also.

By a modification of the operation before described for removal of the sac, the testicle is cut down upon and detached from its connections with the canal and rings. The sac is then tied close up to the deep ring and cut off short. It is again stitched up below with fine catgut, and cut close to the testis, leaving the fundus for a *tunica vaginalis*. The spermatic duct, with its vessels and nerves, is then stretched gently, but firmly, by laying hold of the testis and drawing forwards and downwards. In this way an inch to 1½ inches will usually be gained in length, and the gland may be drawn down and placed in the scrotum so as to lie below the level of the symphysis pubis. It is held in the scrotum by a stout catgut ligature passed with the handled needle through the scrotal tissues below the testis and serous tunic, which are probably the remains of the gubernaculum. The two ends of the ligature are passed separately through the skin of the scrotum and tied over a small pad of carbolised gauze. In some cases, where the cord or spermatic duct did not yield sufficiently to traction, the duct was cautiously separated from the epididymis in the lines of cleavage of the connective tissue, from the globus major down to the globus minor. The gland was then turned upside down, so as to gain the length of its long diameter, and fixed in the scrotum as before described.

The extremely convoluted arrangement of the spermatic duct, and its elasticity within its fibrous envelopes, permit of this stretching without damage to its structure by using too much force. To prevent as far as possible the elastic retraction which follows to some extent, a stout silver wire or tendon suture should be carried deeply through the scrotum directly above the testicle, and this has also been supplemented by elastic traction upon the pad and ligature at the bottom of the scrotum.

In most cases the testicle has become adherent to the scrotum where placed. In some, a certain amount of subsequent retraction has drawn the testicle into the angle between the adductor muscles and the penis. It was, however, in this retired position sufficiently protected from violence or pressure, and was not by any means so liable to be crushed or injured as in its original position in the groin. In one case there has been suppuration in the new tunica vaginalis formed from the fundus of the sac of the hernia. No atrophy of a testicle which was well developed before the operation has occurred. In one case, a child eight years old, in which the testicle was transplanted to enable a truss to be applied to the hernia which followed it, the testis, which was originally wasted somewhat, finally disappeared, either from the operation, or by the truss-pressure subsequently kept up upon the newly formed cicatrix resulting from the operation.

Radical Cure after Herniotomy for Strangulation in Inguinal Hernia.—Since the writer published the first case of this operation in the Address on Surgery at the British Medical Association meeting in August 1873, he has operated in eight cases of *strangulated inguinal hernia* after relief of the strangulation, the intestine being in a comparatively healthy condition—i.e. not sphacelated or ulcerated, but only chocolate-coloured from congestion. The operation was completed by the ligature and removal of the sac, and ablation of diseased omentum; then the sides and rings of the inguinal canal were drawn together by either wire, catgut, or tendon, and the wound stitched up over a drainage-tube. In one case of *reduction en masse* he has done this with complete success. The same operation was done in eight cases of strangulated *crural hernia*. Two deaths resulted, from the damage done by the strangulation and not by the operation.

Operation for the Radical Cure of Crural Hernia.—For this operation the same instruments and appliances as in that for inguinal hernia are used by the writer. The parts, the instruments, and the hands of the operator being carefully purified, the skin closely shaved, and the hernia, if possible, reduced, a vertical incision, 1½ to 2 inches long, is made over the centre of the hernia, and layer after layer of tissue divided with a small scalpel or tenotomy knife until the sac is reached. This is opened on a director, or by the careful use of the scalpel and forceps, and any omentum which may be present is drawn out gently and spread out, so that the vessels which supply it can be recognised. These are to be taken up with the point of the forceps, and tied with the finest catgut, wherever needed. The omentum is then to be held steady by the assistant, and cut off with a pair of blunt bent scissors, or torn carefully with the fingers and forceps.

All the bleeding vessels are to be tied carefully and kept exposed to the air and spray for a while, to make sure that bleeding will not recur. The omentum may then be suffered to retract into the abdomen. The sac is then drawn firmly downwards and forwards. A piece of strong catgut or prepared tendon, doubled, is then to be passed through the neck of the sac, and tied on each side, as high up as possible. The ligature and the sac are cut off close, and allowed to retract into the abdomen. Then the needle is passed through the pubic portion of fascia lata, just internally to the femoral vein, which is to be carefully protected with the forefinger. The point of the needle is carried upwards and forwards, through Poupart's ligament, and brought out at the upper end of the skin wound. A stout piece of prepared tendon is threaded through the eye of the needle and drawn back through the tissues. The needle is then cleared, and passed through the same structures—viz. the pubic fascia lata and Poupart's ligament close to Gimbernat's ligament, the surface and border of which is closely skirted. The other end of the ligature is then threaded through the eye of the needle, drawn down into the wound, and released. If the rupture be a large one, a third ligature may be placed through the same parts, between the other two; or the end of the ligature may be carried across, through, and behind the fascia lata, close to the pectineal line, to obtain a firm hold of those tissues. The ends of the ligature are then tied firmly in a surgeon's knot and cut off short. It will be found, if rightly applied, to close up entirely the femoral hernial opening. A few horse-hairs or a small india-rubber tube, for drainage, should be applied in the lower part of the wound, the upper part of which should be closely sutured with silk and dressed. The patient should be placed in bed sitting, with the knees drawn up. This operation may be performed in favourable cases without taking away either sac or omentum.

Operation for the Radical Cure of Umbilical Hernia.—The operation originated and employed by the writer is performed by the aid of a stout needle, cockspur or semicircular in shape, and with or without handle, carrying a flexible silver wire or thick, stout, aseptic tendon or catgut about 12 or 14 inches long. The instrument and ligature should be steeped for a quarter of an hour in a 1–20 carbolic solution, the patient's navel be well cleaned out, and the neighbouring parts, as well as the operator's hands, be washed with a 1–30 solution.

Then, under an anæsthetic carried far enough to prevent all struggling, the point of the forefinger or, in small cases, the little finger, should press in the protrusion and invaginate the sac so as to make sure that all the parts round the navel are free from bowel and omentum. The needle—unarmed if a handled one be used, but armed with the ligature if an ordinary cockspur or semicircular one be employed—is passed along the front of the finger and made to pierce, from behind, the fibrous structures and skin, about half an inch from the margin of the aperture, leaving a loop at the puncture thus made. The needle and one end of the ligature are then carried round under the skin, close upon the tendinous aponeurosis, just one quadrant of the circle of the hernial aperture, and brought out again to the surface, as in tying a nævus subcutaneously. The needle, if a handled one, is then freed from the ligature. The invaginating finger is again placed on the deep surface of the edge of the hernial opening opposite to this point (or, if preferred, in small cases, the spoon end of a common director can be substituted for it), and upon this the needle is to be again passed through the aponeurosis and skin-aperture occupied already by the ligature, and the end of the latter threaded through its eye and drawn through. These steps are to be repeated for each of the remaining quadrants of the circular hernial opening, carrying the same end of the ligature all round the margins of the aperture and neck of the hernial sac. By traction upon both ends of the ligature (wire, catgut, or tendon) the neck of the hernial sac is closed up firmly, the fundus being gathered up by a pair of hooked forceps and puckered like a sack's mouth when tied. The ligature may be secured by tying or twisting in two separate halves if the case be a large one. By these means the deep surfaces of the peritoneal sac are closely applied to each other in the grip of the ligature. In children's cases stout prepared catgut or tendon should be used. In larger adult cases the writer prefers the use of moderately stout silver wire. The latter ulcerates gradually through the tissues enclosed in its grip, and may, at the end of a week or ten days, be removed with ease on account of the ulcerative action enlarging the track in which it lies. Antiseptic treatment and dressing may be used in both ways of operating. When catgut or tendon is employed it is the more necessary to prevent septic changes, which will cause the ligature to set up suppuration and become discharged, with some delay—perhaps considerable—in the course of the after-treatment.

Two cases of this operation of which notes were kept were in healthy young men. One was afterwards admitted into the army, after having been refused before the operation by the medical examiners. There were no bad symptoms whatever in any of the cases in which the writer has operated, and convalescence was speedy, especially in children.

In the great majority of cases, children can be cured by the maintenance of efficient truss or belt-pressure, carefully applied and sedulously kept up. The writer is of opinion that the pad should be hard, firm, and flat, and should present no boss or projection to be forced into the hernial aperture. If such projection be effective, it delays or prevents contraction of the hernial opening. If not effective, it lies anywhere but opposite to the hernia, and hinders really efficient support to the hernial weakness.

A flat circular disc of lead the sixth of an inch thick and four times the diameter of the hernial opening, slightly bent into a ridge to fit the median abdominal groove when this is deep, covered with wash-leather and held on by a jean or rubber belt, has been found to be the best for children, and seldom fails to cure the rupture in a year or two. When this is borne with difficulty, an air-pad may be fitted to the surface of the metal disc to make it more comfortable and easier to be worn.

In children, the hernia should be cured by pressure before the age of ten years, or be submitted to an operation. Each year after that diminishes the chances of a radical cure.

There are but few adult cases, comparatively, which are good subjects for operation upon this kind of hernia. They are commonly stout, with protuberant abdomens and a large accumulation of intra-peritoneal and surface fat. Often the liver and stomach are troublesome, and sometimes the kidneys are not sound. These patients should be made as comfortable as possible by air-pads, bags, and belts.

In exceptional cases, the radical cure of umbilical or ventral hernia may be attempted after the operative relief of strangulation and division of the point of stricture, by a method of closure of the aponeurotic opening similar to that just described. The sac may previously be tied at the neck with stout catgut or tendon and removed. All should be done with careful antiseptic precautions, and not upon flabby subjects with protuberant and tense abdomens.

With respect to the numerous attempts at the radical cure of hernia by various operators, the conclusion of the author, after a study of the numerous published cases of other surgeons, and the practical experience of his own 409 operations, is that the *mortality* of the operation depends chiefly upon the proper selection of cases, partly upon care and skill in the steps of the operation, and partly upon various accidental risks from other sources; while the *successful issue* depends chiefly upon the skill and experience of the operator, and partly upon due care in the selection of cases and the method of operation.

John Wood.

HERNIA, Reducible.—In this condition the hernia can be completely returned into the abdominal cavity. Herniæ are, in the large majority of cases, slow in their increase; occasionally, however, they suddenly acquire large proportions. In these, which are usually of the inguinal variety, the protrusion descends into a sac already existing, and thus constitutes one of the forms of congenital hernia.

The earliest symptoms of reducible hernia are the presence of a swelling, associated with dyspepsia, lumbar pain, and a sense of weakness in the region through which the hernia is protruding. Whilst the hernia is advancing through the abdominal walls its progress is slow, taking often many months before it becomes complete. After it has once passed beyond the limits of the retention-action of the abdominal muscles, its progress is usually rapid.

Herniæ increase from ill-health, excessive muscular action, and from carelessness, sometimes attaining enormous proportions. If small, the protrusion returns spontaneously when the patient assumes the recumbent position; but if large, some portion of the hernia usually remains down. The hernia is always more easily reduced whilst the patient lies down, but can be returned with varying difficulty even in the erect position. If the protrusion consists of an entero-epiplocele, the intestine is usually the first part to be returned, followed by the omentum. Should the hernia be composed entirely of intestine, the tumour is soft, more or less resonant on percussion, with a distinct impulse on coughing, and yielding frequently a gurgling sound on the taxis being applied; if the hernia consists of omentum, the swelling is soft, doughy, dull on percussion, lobulated, with no distensile impulse on coughing. In adults the intestine is usually returned gradually; in early infancy, owing to its being more tense, the intestine is frequently returned suddenly. Omentum is nearly always replaced gradually, and often with much difficulty.

In the very early stages of a hernia the sac may be reduced, but it soon acquires adhesions to the surrounding connective tissue, and thus becomes irreducible.

The treatment of a rupture consists either in the palliative method of wearing a truss, or in the adoption of the radical cure, which aims at closing the aperture through which the hernia protrudes by operation. *See* HERNIA, Radical Cure of.

The palliative means are those usually adopted. In infancy the truss should be applied as soon as the hernia is discovered, and should be worn day and night, only being removed three or four times in the course of the day for the sake of cleanliness and readjustment. In adults it must be worn in the day-time, and should be applied before rising from bed, and removed after retiring to rest. If the hernia does not descend at night the truss need not be worn, but if any portion should descend, then the instrument should be worn day and night. *See* TRUSSES.

If a patient who is the subject of a hernia begins to wear a truss before the age of ten, a permanent cure may, in the very large majority of cases, be confidently anticipated after wearing a truss for a few years; after the age of puberty the likelihood of recovery is much lessened; while if the hernia appear after twenty years of age, the patient should be advised to wear a truss for the remainder of life, even if there is no descent of the bowel.

JOHN LANGTON.

HERNIA, Strangulated.—*Definition.* A strangulated rupture may be defined as one in which there is (1) an obstacle to the passage of the gut back into the abdomen; (2) an obstacle to the passage of the intestinal contents; and (3) an obstacle to the passage of blood through the involved loop. These three factors must all be present to constitute a strangulated hernia. If one alone or two alone be present, the rupture is other than strangulated. Thus if there be only an obstacle to the passage of the gut back into the abdomen, the hernia is simply 'irreducible,' while, if there be an obstacle to reduction, as well as an obstacle to the passage of the intestinal contents, the hernia is classed as 'obstructed' or 'incarcerated.'

METHODS OF STRANGULATION. — A knuckle of gut is thrust through a narrow strait or aperture, and, being unable to return, becomes strangulated. When once the bowel has been snared, all further evils which befall it depend indirectly upon the blood-vessels. The vessels are compressed; the blood is unable to return to the great veins; the part swells; the strangulation is thereby rendered more pronounced, and the lack of a supply of fresh blood soon imperils the life of the captured loop. It is obvious that were the intestine non-vascular it could not become strangulated in the usual sense of that term. The gut is thrust through the hernial orifice by a pressure acting from the abdominal cavity. As it is being forced through the narrow aperture, its shape is altered in such a way that its long axis is more or less at right angles to the plane of the hernial orifice. When, however, it has passed through that orifice, it tends to assume its natural outline, and its long axis becomes parallel to the plane of the said opening. Its return, however, is soon rendered still more difficult by reason of the swelling which it undergoes.

The constricting agent is sometimes the neck of the hernial sac itself, sometimes the dense tissues which form the margin of the hernial orifice, and which have indeed moulded the neck of the sac. In recent herniæ, and in congenital herniæ that are of not too long standing, the neck of the sac cannot form the constricting agent. In such ruptures it has indeed no independent existence. If all the tissues about it be cut away, the neck can be drawn out as a part of a perfectly flat piece of peritoneum. If a square bag be pushed through a small ring, it will appear to have a neck where it is encircled by the ring, but if the latter be broken the neck ceases to exist. After a hernia has existed for some time, the plaits and folds into which the peritoneum is thrown at the neck of the sac become matted together; the tissue immediately external to the neck becomes condensed, and the neck acquires an independent existence. In such a case, if all the structures about it be divided, it still exists; and even if the hernial sac be separated from the body, it will still appear as a bag with a definite and rigid constriction for a neck. In certain old ruptures of large size, the neck of the sac may become almost as tough as a ring of cartilage.

In some instances the gut in a rupture has been strangulated by bands of adhesions which pass from one wall of the sac to another, or it has been so compressed beneath a strip of adherent omentum as to be occluded, or it has been closed by being thrust through a slit in a portion of adherent omentum.

There are instances where an occlusion of the bowel, leading to symptoms of acute strangulation, has been brought about by a twisting upon itself of a loop of gut within the hernial sac. Here the strangulation is due to two distinct causes acting in concert, viz. the volvulus of the bowel, and the rigid neck of the sac, or the adhesion within that sac, which has rendered the volvulus possible and has maintained it when once it has formed.

Strangulation commonly follows the protrusion of an unusual amount of intestine. It is thus often ascribed to sudden exertion, to violent expulsive efforts, to injuries causing compression of the abdomen, and the like. In many instances, however, there has been no such feature in the etiology. The rupture has become strangulated while the individual was at rest, and even while asleep. In certain of these cases the patient has been for some time out of health; his tissues are relaxed, or he has been troubled with colic, with severe indigestion, with constipation, with diarrhœa, or some such intestinal trouble. Some authors lay great stress upon the intestinal disturbances that are certainly often to be noted in cases where a rupture has become strangulated without conspicuous cause. They maintain that such disturbances have a paramount influence in the production of the strangulation.

A hernia may become strangulated on its very first appearance, as is not infrequently the case in some congenital inguinal ruptures. On the other hand strangulation may appear for the first time in a hernia that has existed for many years, that has always been reducible, and has never given serious trouble. It may appear in a hernia that is in whole or in part irreducible. When it involves a rupture that has been for a long time wholly irreducible, the symptoms probably depend upon the snaring of a new and recently descended knuckle of gut.

Strangulation is most commonly met with in the herniæ of adults. It is comparatively rare in children and in old age. It is somewhat more often met with in males than in females. Reducible herniæ are more often strangulated than irreducible, small herniæ than large, and congenital herniæ than acquired.

Symptoms.—A typical case.—A labouring man has a common inguinal hernia. Apart from the rupture, he enjoys perfect health. He has had the hernia for several years; it has always been reducible, and he has worn a truss. On several occasions, probably, the gut has come down, and he has had much difficulty in forcing it back again, and, during his efforts to effect this end, the rupture has pained him a good deal, he has felt uncomfortable in his abdomen, and a little sick and faint. On a certain day he goes to his work, and, during some unusual exertion, the rupture suddenly descends behind the truss. He at once removes the truss, and endeavours to reduce the hernia as on previous occasions, but fails. He has a good deal of pain about the neck of the sac, and feels sick and faint. Possibly a cold perspiration breaks out over his forehead. He makes his way home with difficulty and lies down. By this time the sensation of sickness has increased, and he has vomited. The vomiting becomes more marked with each hour that the strangulation exists. He first brings up simply the contents of the stomach, then a yellowish fluid deeply stained with bile. As the case advances, the vomit becomes of a deeper colour, a dullish green, and ultimately a watery fluid that is brown and ill-smelling. It may in time become feculent.

The bowels may act once or even twice after the strangulation has set in. Probably, however, they do not act at all. When sufficient time has elapsed, the patient finds that he is constipated, and that the constipation remains absolute. Not even does flatus pass the bowel. One most conspicuous symptom is the great constitutional depression. The man, who a few hours ago was in vigorous health, is now utterly prostrate. His pulse has become rapid and feeble, and may rise to 120 or 140. His temperature is below normal and remains so; his skin is cold; his face looks pinched; his eyes begin to appear sunken. He looks prematurely old, and such expression as his face may wear is indicative of great anxiety and distress. The tongue becomes coated, is at first white, but soon becomes dry and brown. As the case advances he becomes troubled with intense thirst. Whatever he drinks he vomits again, and the more copious the vomiting the more marked the thirst. The amount of urine that he passes is diminished, and often conspicuously so. If the abdomen be examined, it presents a normal appearance. When the case has lasted for some time, it may become swollen, but the distension will never be great. Besides the pain about the hernia, the patient has severe abdominal pain—pain of the nature of colic, it may be, or a more constant pain that is situate about the region of the umbilicus. The abdomen is not at first tender on pressure, but it becomes so in time, and manipulation of the belly, or examination of the rectum, probably causes increased suffering and an attack of vomiting.

On examining the hernial tumour, it is found to be larger than usual, very tense and even hard, dull on percussion, tender, absolutely irreducible and without impulse on coughing. On percussing the abdomen in the immediate vicinity of the neck of the sac, there may be some dulness due, to the presence of a distended coil above the rupture. If left alone the patient becomes worse hour by hour. The collapse deepens; the vomit may now come up in great gushes, or it may somewhat abate. He does not appear to suffer very acute pain. He lies in bed, restless, yet utterly prostrated, and in a state of faint and desperate misery. The collapse may be such as to resemble that of the algid stage of cholera. The urine may be suppressed. There may be some delirium. In all probability, however, the collapse deepens, and the patient simply dies of exhaustion.

A patient, with an unrelieved strangulated hernia, may die in forty-eight hours, while, on the other hand, he may live a fortnight or even longer. The prognosis in such a case depends upon many factors—upon the age and state of the patient, the nature of the hernia, and the degree and position of the strangulation. Probably the average duration of a case of unrelieved strangulated hernia would be as long as seven days.

Analysis of the Symptoms.—The first symptoms of strangulation are evidently due to the impression conveyed to the abdominal nervous centres by the damage to the bowel; the later symptoms are due in part to this cause and in part to the actual obstruction of the intestine. The small intestine is usually the part of the bowel involved in a hernia. It is supplied by the superior mesenteric plexus of nerves—a plexus of considerable extent, which comes off almost directly from the great solar centre. The faintness, the collapse, the failing pulse, the early vomiting, can all be ascribed to disturbance of the great abdominal nerve-plexuses.

It is obvious that the vomiting, which may appear almost immediately after the strangulation, cannot be directly due to an obstruction in the bowel as far down as —let us say—the lower ileum. The more severe and abrupt the strangulation, the more marked are the symptoms of general constitutional depression and the more pronounced the vomiting. Later on active peristalsis is excited in the gut, above the obstruction, and by means of this movement the vomiting is kept up so long as the obstruction exists. Feculent vomiting may occur when the lower ileum is involved. It would rarely appear before the fourth or fifth day. In any case where the symptoms have lasted many days, the vomited matters possess an offensive smell —'an intestinal odour;' but it is doubtful if they can become really stercoraceous unless the strangulation be low down in the ileum.

The constipation is to be ascribed, in the first instance to the sudden shock given to the abdominal nerve-plexuses, whereby the bowel is paralysed, and in the second to the obstruction. In the majority of cases no motion is passed after the snaring of the bowel, and it cannot be presumed that in all these cases the whole of the intestine below the obstruction is empty. Yet although the colon may be filled with fæces at the time of the accident, those fæces are not evacuated. All the excitement and tumult within the abdomen is taking place in the part of the intestine above the occlusion; the part below remains quiet, inert, and functionless.

The pain experienced depends (1) upon the direct damage to the bowel; (2) upon painful impressions referred to the great solar plexus; and (3) to violent and irregular peristaltic movements in the bowel above the herniated segment. Pain due to the first cause is mostly felt at the neck of the sac, and an examination of that part reveals some tenderness. The fixed pain which patients so often complain of, about and especially above the umbilicus, is, the writer thinks, due to an impression made upon the central nerve-plexuses, to pain referred to the solar centre. Peristalsis of the bowel, above the hernia, causes the colicky, wandering pains which are felt more or less all over the abdomen, and which assume a paroxysmal, although not an intermittent, character. Extreme tenderness of the abdomen is not usually met with in hernia. When present, it probably indicates peritonitis, and is associated with great tension of the abdominal parietes, and increasing meteorism.

The diminished excretion of urine depends partly upon the large amount of fluid lost by vomiting, but to a much greater extent upon the abrupt disturbance in the abdominal nerve-centres. The renal plexuses, it may be observed, are directly derived from the solar plexus and its semilunar ganglia. The diminution in the urinary secretion is most marked in cases attended by severe constitutional symptoms. It has no direct connection with the seat of the strangulation. It is, undoubtedly, usually more marked the nearer the obstruction is to the stomach; but it must be borne in mind that the higher the site of the strangulation, the more severe are the symptoms apt to be, and the more marked and profuse the vomiting. The jejunum, with its muscular walls, its copious blood-supply, its well-developed nerve-plexuses, and its vigorous functional activity, would resent an injury more energetically than would the lower ileum, where the muscular tissue is so much scantier, the blood-supply less free, and functional activity less pronounced.

The local changes in the hernial tumour are all intelligible enough. The most important feature is the loss of all impulse on coughing. The tension of the swelling depends in part upon the increased amount of gut in the sac, in part upon the swelling of the bowel, and in part upon the collection of serum in the sac. The dulness on percussion depends in most cases upon the presence of the serum. It may be due to omentum between the bowel and the anterior wall of the sac. The amount of gas within the herniated loop is often so small, and the swelling of its coats so extreme, that even when the bowel is pressed close to the sac-wall, the percussion note is still dull. From the condition of the gut, the tumour may be expected to be tender on handling, but pronounced tenderness probably indicates hernial peritonitis, i.e. inflammation of the serous lining of the sac and serous covering of the bowel.

Variations in the Symptoms.—The symptoms vary in different cases. The main bases for such variations are the age of the patient, the state of the health, the nature of the hernia, the portion and amount of gut involved, and the treatment adopted. In general terms it may be said that recent herniæ cause more severe symptoms, when strangulated, than do old herniæ; that small strangulated herniæ are more acute than large, and that strangulation of a reducible rupture is usually more serious than that involving an irreducible one. When congenital herniæ are involved, the symptoms are, as a rule, more urgent than when corresponding acquired ruptures are implicated.

It would appear that the symptoms are often less severe when omentum is involved with the bowel, the omentum possibly offering some protection to the intestine. Strangulation is commonly attended with graver manifestations in the young than in the old, and much of the future course of a case depends upon the abruptness and vigour of the strangulation.

It is often seen that strangulated herniæ are attended with urgent symptoms in those who are in vigorous health—in individuals whose processes are active, whose vessels are well filled with blood, and whose nerves respond readily to stimulation; while, on the other hand, in the delicate, the anæmic, the individual whose muscular system is flabby and inert, the course of a strangled rupture is often attended by disturbances of a much more moderate character.

In some of the most acute cases the collapse is very pronounced. There is rapid prostration, the skin is cold, the limbs are cyanotic, the voice is lost, the urine is suppressed, and cramps seize upon the extremities. During epidemics of cholera, this ultra-acute form has actually been mistaken for that disease, and French authors have indeed named it 'cholera herniaire.' On the other hand, in some of the least acute forms, the symptoms develop gradually. There is some colic, some pain in the hernia, some tenderness about it; the bowels do not act, and the patient vomits occasionally, and only, most probably, after food. Three or four days may thus be passed before the characteristic symptoms of strangulated hernia set in. Symptoms of this nature are most commonly met with in ruptures of large size.

Among some of the least usual phenomena met with may be mentioned severe and extensive congestion of the lungs (Verneuil), cramps in the limbs, delirium, and, in children, convulsions.

The three most important and constant symptoms are the constitutional depression, the vomiting, and the constipation. The last-named symptom may, however, be replaced by an evacuation of the bowel below the obstruction.

The local manifestations are liable to variation, and, in the diagnosis of strangulated hernia, must assume a somewhat subordinate position.

When the hernial tumour presents all the characters which have been mentioned in describing a typical case, the evidences of strangulation are very powerfully confirmed; but it must not, on the other hand, be assumed that the absence of one or more of those characters is inconsistent with strangulation, or any evidence that it is not present. The local symptoms may be quite insignificant. In many instances the patient has been quite unconscious of having a rupture, and the swelling has been discovered for the first time by the surgeon. The tumour, moreover, may be of such small dimensions, and so deeply placed, that it can hardly be subjected to examination, and presents characters that are negative or questionable. In some herniæ, such as the obturator and sciatic, it may not be possible to distinguish any tumour after careful examination.

In small herniæ the absence of an impulse on coughing is often difficult to clearly establish. Tumours which are of small or moderate size will probably be dull, hard, and tense. The same characters may be noted in even large swellings. But a patient may present a tumour that is apparently, in all parts, soft, fluctuating, and perhaps resonant on percussion. Yet such a swelling may be the seat of a strangulation. The tumour in such a case will be large, and will contain mainly certain unstrangulated loops, while probably, deep at the neck of the sac, is a little knuckle of strangled intestine which is beyond the reach of the surgeon's touch. Such tumours are usually met with in cases where a large irreducible hernia becomes the seat of a strangulation. On the other hand, a hernial tumour may present the principal characters which are associated with strangulation, and yet not be the seat of the affection. This is seen in connection with small inflamed and irreducible epiploceles, especially when situated in the femoral region. In such a case the little tumour is irreducible, is hard, tense, and dull on percussion, and either presents no impulse on coughing or only equivocal evidence of that symptom. The swelling, moreover, is tender on pressure and painful.

Conspicuous alterations may be noticed in the hernial tumour as the result of certain gross changes in the ensnared bowel or its sac. Thus, when a high grade of inflammation attacks these parts, the tumour becomes more tense and dull upon percussion, more painful and tender, while the skin over it will probably be found red and œdematous.

When gangrene attacks the entrapped intestine, and perforation follows, the tumour may be found to have become soft, and to feel doughy to the touch. It may have ceased to be painful, and may be resonant on percussion from the presence of gas in the sac. When suppuration follows as the result of such a change, the swelling presents the ordinary characters of an abscess (fæcal abscess).

It may now be convenient to consider whether symptoms, similar to those which attend strangulation of the bowel, may attend strangulation of the omentum, and whether the strangulated epiplocele is to be admitted into the clinical conception of a strangulated rupture. That omentum may become strangulated must be admitted, although its physical conditions are such as to render that occurrence much more unlikely to happen than in the case of the bowel. There are surgeons who, while they are compelled to admit the anatomical possibility that omentum may become strangulated in a rupture, yet will not allow that that accident is attended by symptoms in any way allied to, or apt to be confused with, the symptoms of strangulated enterocele. As to the precise symptoms—if any—which attend the strangulation of omentum, they are either silent or at variance with one another, and are thus disposed to ignore the clinical existence of a condition whose anatomical status they readily recognise. They agree in asserting that a strangulated epiplocele cannot give rise to the ordinary symptoms of a strangulated hernia, and the solitary argument upon which this assertion is based, may be expressed in the words of the surgeon who asks, 'If the ligature of omentum, by the surgeon's hands, produce no symptoms of strangulation, how comes it that the comparatively slack constriction of a hernial neck can be supposed to do so?' This question may be at once answered. There is an immense pathological difference between a lesion which merely irritates nerve-filaments and disturbs function, and a lesion which at once destroys nerves and totally annihilates function. The constriction of the hernial neck acts as a severe irritant to the nerves of the part, and greatly disturbs its circulatory conditions; the surgeon's ligature, on the other hand, is so tight that all tissues within its grasp are killed; the parts on the distal side of the thread are at once practically destroyed, and cease to share in the activity of the body.

Strangulated epiplocele may produce symptoms which resemble, and may not always be distinguishable from, those attending a strangulation of the bowel, and into the clinical conception of a strangulated hernia, this form of rupture must be admitted. The special features that may mark the strangulated omental hernia, as compared with the rupture containing bowel, are well described by Mr. Bryant: 'It is characterised by less severe and acute symptoms. They are the same in nature, but different in degree. The pain is less severe, the vomiting not so marked, constipation is less complete and insuperable; the constitutional symptoms are milder; the local distress is also inconsiderable, the tumour permitting manipulation more freely than when it contains intestine. It will also feel harder and more nodular.'

It is quite possible that many instances of hernia, classed as strangulated omental, have been instances of error in diagnosis. For example, symptoms of such severity may attend the inflammation of an irreducible epiplocele that they may be confused with the evidences of strangulation; and, on the other hand, in herniæ containing much omentum, a little strangulated knuckle of gut may be overlooked when kelotomy comes to be performed for the relief of obstructive symptoms.

LITTRE'S HERNIA.—This name has been given to a form of strangulated hernia, where only a part of the circumference of the bowel is strangulated by the margin of the hernial orifice. The part of the intestine involved is that most distant from the attachments of the mesentery. When the condition has been relieved, the portion of the wall of the gut which has been strangulated will appear as a sharply-defined, rounded swelling, projecting from the surface of the intestine. It may look, indeed, like a nipple-shaped diverticulum, and, as a matter of fact, in the earliest cases described a small Meckel's diverticulum had found its way into a hernial sac and had become strangulated. The nature of these cases was not recognised, and the diverticulum was supposed to have been produced by the strangulation. In a genuine Littre's hernia normal small intestine is involved, and the little saccular swelling pinched up on the surface of the bowel is produced solely by the constriction. In this form of hernia the intestine may be very firmly held, and a part of its wall so rigorously constricted that it becomes gangrenous, while all the time the lumen of the tube is not obliterated. This form of strangulation is rarely met with, except in femoral herniæ. It occurs usually in quite recent herniæ in young adults, and for the most part in individuals who have no suspicion that they are the subjects of rupture. The symptoms resemble those which are associated with an ordinary strangulated enterocele. They are, on the whole, somewhat less acute, the vomiting is less marked and persistent, and the bowels may continue to act during the whole progress of the case. In many instances the intestine becomes acutely bent or kinked at the seat of the strangulation, and, under such circumstances, the bowel is entirely occluded, and the symptoms differ in no way from those of an ordinary strangulated rupture. In Littre's hernia the tumour is very small, and is often overlooked. When the patient is stout, and the portion of gut occupies the femoral ring, the presence of a tumour may not be detected, even after careful examination. In such instances there will merely be pain and tenderness about the part, in addition to the ordinary signs of strangulated bowel. If the strangulation be not speedily relieved, the ensnared portion of intestine will rapidly become gangrenous.

DIAGNOSIS OF STRANGULATED HERNIA. The special points which serve to distinguish a strangulated rupture from one that is merely inflamed or obstructed will be considered when dealing with the two last-named forms of hernia. The symptoms attending an acutely strangulated hernia may resemble those arising from acute peritonitis. In examples of hernia, with ill-marked or misleading local evidences of rupture, the two affections have been confused with one another. The chief points in the differential diagnosis will be found described in the table of diagnosis of intestinal obstruction. *See* INTESTINAL OBSTRUCTION.

A strangulated hernia is readily diagnosed from an internal acute obstruction by the presence and condition of the hernial tumour. Should all local evidences of rupture be absent in any instance, the diagnosis of the two conditions would be obviously impossible. In several cases the abdomen has been opened to relieve a supposed internal strangulation, and the cause of the symptoms found to depend upon a hernia.

In other instances where obstruction-symptoms existed, a hernial tumour has been cut down upon, the gut within it found unimpaired, and the patient's death, or a further operation, has revealed an obstruction deep in the abdominal cavity.

In a child an undescended testicle, which is retained in the inguinal canal and has become inflamed, may, as already stated, give rise to symptoms like those of strangulation. In the diagnosis, the absence of one testicle from the scrotum will be noticed. The surgeon will probably be able to feel and define the upper limits of the tumour. The tumour will be harder than is usual in hernia; it will also be much more painful and more tender. The constitutional symptoms, and the vomiting and constipation, will be all much less marked. Indeed, the local symptoms will usually quite outweigh the constitutional.

The certain diagnosis of the contents of a strangulated rupture is not usually possible. The sac is tense, and distended with fluid. It is uniformly dull, and in all parts equally resisting. There is, indeed, a singular sameness in hernial tumours of like size and position, when they have been for a little while the seat of a strangulation.

THE MORBID ANATOMY may be considered under three headings:—1. The tissues outside the sac. 2. The sac. 3. The contents of the sac.

1. The tissues outside the sac. These will vary in thickness and character according to the anatomical situation of the rupture. They may be found quite normal as the parts are displayed when cutting down upon the sac, or may be the seat of inflammatory œdema, or, when rough taxis has been applied, of some extravasation of blood. In cases of suppuration of the sac, or of the formation of a fæcal abscess, the tissues outside the sac may simply appear as the wall of an abscess. In some instances a well-localised collection of fat has been found between the layers of tissue covering the sac, or has appeared in the connective-tissue layer immediately external to that structure. To such collections the French have given the name 'Lipome herniaire.'

2. The sac. The sac may be entirely absent, as is usual in hernia containing part of the urinary bladder, or it may be incomplete, as is commonly the case when the cæcum is herniated. The adhesion of the sac to the tissues immediately external to it is usually slight, especially in recent and in congenital ruptures. In old herniæ, and particularly in such as are irreducible or have been inflamed, the sac is often closely blended with the parts around it. In any case the neck will be more adherent than the fundus. In recent, and in congenital herniæ, the wall of the sac is thin, but when the rupture is of long standing, and especially after it has been inflamed or the seat of obstruction, it may become thick and dense. The pressure of a truss undoubtedly tends to promote this thickening. The sac-wall may be thick at one part and thin at others. In these latter situations it may have become distended, so as to appear lobed.

In some cases two sacs may be found in the same tumour, as when an external and an internal inguinal hernia have formed on the same side, and the necks of the two sacs are separated only by the epigastric artery. Or, again, there may be two necks to the same sac (hour-glass sac). When this condition exists, a distinct and peculiar hour-glass outline may be given to the rupture. It is supposed that in these cases the original sac of a hernia has been displaced downwards by a fresh protrusion; the original neck then forms the lower constriction or the waist of the hour-glass, while the new sac forms the upper part of the bilobed swelling.

3. The contents. The gut in a strangulated hernia may be found to be free, or the parts of a knuckle may be matted together by old adhesions, or similar adhesions may attach the bowel to the sac-wall. The changes which take place in the snared intestine are as follows:—It becomes congested, the vessels that are at first most conspicuously involved being the veins. The gut becomes a deep purple. It may show arborescent vessels upon its surface, or appear mottled, or display extravasations beneath its serous coat. In the next place it becomes swollen and œdematous. It feels thick, fleshy, and leathery, and is of a deep purple hue. As a further change its surface ceases to be smooth and glistening and becomes dull and sticky, and flakes of lymph may appear upon it. The bowel now loses its elasticity, it feels doughy, and offers no resistance to the finger. It is, in fact, gangrenous. It may present an ash-coloured slough, or may be the seat of a perforation. Where the bowel is constricted, a deep, ring-like groove is formed, which may persist for many days after successful reduction. The perforation, when such exists, may be at the fundus of the loop, and will then probably be small; or a more extensive rupture of the gut from gangrene may be found at the line of the constriction, especially in the upper limb of

the involved loop. The bowel immediately above the strangulated hernia may be perforated, and the escape of the contents into the abdomen be prevented by a number of recent adhesions. In any case the gangrenous change appears to commence in the mucous membrane, and the change is always most advanced in that tunic. The ends of the bowel immediately above the obstruction-line are often fixed to the abdominal parietes about the hernial orifice by recent adhesions. In the interior of the ensnared loop are found flatus, fluid fæcal matter, much mucus, and often a considerable quantity of blood. The mesentery of the strangulated coil is greatly thickened, is œdematous, and often the seat of extravasation.

Any omentum in the sac may be found congested, inflamed, or gangrenous. It may be free or adherent. Its tissue may show none but recent changes, or it may, on the other hand, be found to be dense, tough, and fibrous. Sometimes the gut is entirely enveloped and concealed by omentum. This omentum is adherent to the walls of the sac, and forms the condition known as an omental sac.

The serum in the sac varies in appearance according to the state of the gut. It is at first of a pale yellow colour, clear and bright. As the gut becomes more congested, the serum becomes of a dark brown or purple tint, but remains clear. At a later period it becomes turbid, and is mixed with flakes of lymph. When the gut is gangrenous it has a feculent smell, is opaque and of a dull, brownish colour. The serum may possess a distinct feculent odour without the gut being actually perforated, just as an abscess in close connection with the bowel may contain most offensive pus, without communicating in any way with the interior of the intestine.

Treatment of Strangulated Hernia. The treatment of strangulated hernia consists practically of two measures only—the taxis and herniotomy. If the case be seen almost directly after the rupture has become strangulated, there is no doubt that the best treatment consists in placing the patient in the recumbent position, and at once applying the taxis. This is frequently done by the patient himself, and with perfect success. The writer does not think it desirable to administer an anæsthetic in this early attempt at reduction. If the patient recovers from the anæsthetic with the hernia still unreduced, his symptoms will be found to be aggravated, especially as regards the vomiting. Chloroform or ether should not be administered unless the surgeon has resolved to perform kelotomy in the event of the failure of the taxis. If the gut cannot be reduced on the first attempt, and if the symptoms have only just set in, and there is no vomiting, it is well to try for a while the local application of ice. Some surgeons advise, in the place of ice, a long-continued emersion of the body in a hot bath. This measure, however, is usually very exhausting, and entails an undesirable amount of exertion on the patient's part. What effect the ice will have upon the tumour it will exercise within four or five hours; and if at the end of that time no benefit follows, the prolonged application of the ice-bag is not to be advised. After the ice-bag has been applied for some five hours, or for a longer period, if the symptoms be not urgent, taxis may be once more attempted, and if it again fails, the operation of herniotomy must be perfumed.

Taxis *versus* Herniotomy.—It is usual to consider that of these two procedures the latter is the more serious. The common advice is—'If the taxis fails, resort to herniotomy.' This latter operation is regarded in the light of a *dernier ressort*—a desperate final measure. Comparing, however, these two measures simply as operations, and without regard to their individual merits in any one special case, the writer would urge that the taxis is certainly the more serious and hazardous operation of the two. In the taxis an attempt is made to push the ensnared bowel into the abdomen by main force. There is no question of 'manipulation,' as that term is ordinarily used in surgery. There is no manœuvre of a kind similar to that by means of which the head of the humerus is coaxed into the glenoid cavity after a dislocation. It is merely a question of which is the stronger, the constricting ring or the surgeon's hand. The object upon which this force is expended is a bladder-like knuckle of intestine, whose walls are engorged with blood, are œdematous and softened, and possibly on the verge of gangrene. It is true that the force applied by the surgeon is modified and more evenly distributed by the fluid within the hernial sac, but that fluid is not a protection against all degrees of pressure. The measure, moreover, is an operation performed more or less in the dark. The surgeon may actually be in the anomalous position of endeavouring to introduce into the abdomen a loop of gangrenous intestine. He may readily bring about a perforation, and the only decided effect of energetic taxis may be the introduction of fæcal matter into the peritoneal cavity.

In herniotomy, on the other hand, the parts are not roughly handled; no violence is applied to the delicate and damaged gut. There is a simple incised wound, and a gentle reduction of the ensnared loop, and, in many cases, that is all. It is unnecessary to refer to the opening of the sac, because that is not a *sine quâ non* in kelotomy. It must be remembered that the evil results of improper taxis are commonly placed to the credit of herniotomy. The gut has been seriously damaged by unsuccessful attempts at reduction, herniotomy is performed as a last resort, the patient dies, and another contribution is made to the mortality of the operation. It is impossible to compare the taxis, on the one hand, with herniotomy after taxis on the other. The comparison should be made between taxis and herniotomy without previous attempts at reduction. Of the two operations it must, in strict justice, be owned that taxis is the more fatal, and has been followed by the larger series of lamentable results. A herniotomy is often little more than a clean incision; and the recent vast improvements in the treatment of wounds have certainly helped to make that incision a less serious thing than the crushing of a loop of intestine lying in a state between life and death. The death of the patient can very often be distinctly and directly traced to the operation of taxis, but it is comparatively rare to trace death to the immediate effects of the incision made in kelotomy.

Taxis.—In applying taxis, the parts about the hernial orifice are relaxed as far as possible by the means named in the descriptions of the different anatomical varieties of hernia. The neck of the sac is steadied by the forefinger and thumb of the left hand, while pressure is applied to the fundus by means of the thumb and fingers of the right hand, which should be spread out over the tumour. The nature of the force is a mixture of squeezing and pushing. The pressure should be slowly, evenly, and cautiously applied. The degree of force used must depend upon the judgment of the manipulator. He should keep before his mind the picture of a knuckle of gut, engorged and swollen, protruded through a sharp-edged opening, and possessed of a precarious vitality. Under no circumstances should much force be employed. Violent taxis causes extravasation into the subcutaneous cellular tissue, or into the wall or the cavity of the sac. It may lead to certain displacements of the sac, and to spurious reductions. It may cause rupture of the gut, greatly encourage the development of gangrene and inflammation, and at once render complete a threatening perforation. Violent attempts at reduction always seriously compromise any further measures of treatment. The possible success of the taxis will depend upon data that are both numerous and complicated. Briefly, it may be said that an umbilical hernia is more readily reduced than an inguinal, and an inguinal than a femoral, other things being equal. Upon the same grounds reduction is more likely to be effected in a rupture of moderate dimensions than in one that is either very small or very large. Congenital inguinal herniæ are more difficult to replace when strangulated than are the corresponding acquired forms. The larger a recently-descended hernia has become, the less chance is there of its being reduced, and the same may be said of it the harder and more tense it is.

When the reduction of a knuckle of intestine is successful, the gut passes into the abdomen with a characteristic slip, and often with a gurgling noise; and after its return the sac is found to be empty, and the hernial orifice clear. Omentum, on the other hand, returns slowly and gradually; it does not slip back, nor is its return, of course, attended by any gurgling. Relief of all the symptoms of strangulation follows more or less immediately after the reduction.

There are certain *fallacies* in connection with reduction by taxis which demand close attention. 1. *A successful reduction of strangulated intestine may be erroneously considered incomplete.* This fallacy may arise under these circumstances: there is much omentum in the sac, but only a small knuckle of gut, which is deeply placed. The reduction of the latter may very readily be quite unobserved. In another case there is an irreducible hernia which has existed for years without causing symptoms. Into it descends a small knuckle of fresh intestine, which becomes strangulated. The reduction of this little loop may also escape observation. Or, again, the sac may have an unusually thick or uneven wall, or there may be a localised deposit of fat over it, and after successful taxis it may be thought that something still remains in the sac.

2. *The taxis is considered to be successful, but is attended by no relief to the symptoms.* This may depend upon the following conditions:—1. Reduction *en*

masse. 2. Reduction through a rent near the neck of the sac. 3. Incomplete reduction. 4. Reduction of the gut still strangulated.

1. In the reduction *en masse*, the sac, together with its contents, is pushed forcibly into the abdomen, and as the bowel will still be strangulated by the neck of the sac, the symptoms are in no way relieved. In this event the rupture is made to disappear slowly; there is no slipping back and no characteristic gurgle. After the reduction, a dull, painful tumour may possibly be made out on the abdominal aspect of the hernial orifice. This accident is met with in small and in recent herniæ, and especially in those where the neck is large. It is met with almost exclusively in external inguinal ruptures. In 112 cases of reduction *en masse*, collected by Follin and Duplay, 101 occurred in the subjects of external inguinal hernia, 2 in direct inguinal ruptures, and 9 in the subjects of femoral hernia. A considerable amount of force is required to effect the reduction of the entire sac, and the accident has been frequently brought about by the patient's own attempts at taxis. As soon as the accident is discovered, the canal through which the rupture has escaped should be opened up, the fundus of the sac drawn down and opened, and the ensnared loop liberated.

2. In this variety of pseudo-reduction, the pressure applied to the part causes the sac to rupture. The rent is usually close to the neck, and commonly on the posterior aspect of the sac. By a continuance of the attempts at reduction, the strangled loop is thrust through this rent, and is forced into the subperitoneal connective tissue. In such cases the return of the bowel is effected slowly, and with continued effort. It does not return with a slip, and there is no gurgle. The hernial orifice is found to be still occupied after the supposed replacement, and the symptoms persist. The presence of the strangulated loop in the subperitoneal tissue may be made evident by a dull and tender swelling about the abdominal aspect of the hernial orifice. This accident is met with only in inguinal herniæ, and usually in such as are of the congenital variety. The treatment is the same as for the previous condition.

3. Under certain conditions—as in the very obese—a small, inguinal hernia may be so far returned into the inguinal canal as to be no longer perceived externally, although it remains still strangulated and still unreduced.

4. A loop of bowel lying in a hernial sac may be strangulated by adhesions which pass between the two limbs of the loop, or it may be ensnared by having passed through a slit in the omentum, or between adhesions formed by herniated omentum. Such a loop may be reduced without any relief being afforded to the strangulation. When the reduction is complete, the treatment of the case will demand an opening of the abdomen either in the linea alba, or in the parietes about the hernial orifice.

The consideration of the circumstances under which attempts at reduction by taxis are most to be advised, may be conveniently introduced by pointing out *the conditions in which the taxis is inadmissible.* 1. Attempts at taxis are inadmissible when the parts show evidence of inflammation, when the swelling is extremely tender, and the skin over it is red, hot, and œdematous. 2. In the case of strangulation, involving a rupture which has long been quite irreducible, the prospects of relief by taxis are very remote. 3. The longer the symptoms have lasted in any case, the less marked are the indications for taxis. Every hour renders the possibility of reduction by taxis more distant, and renders the bowel more susceptible to grave damage if roughly handled. It is needless to say that the tumour should not be subjected to manipulation if any suspicion exist that the gut is gangrenous. 4. In recently strangulated herniæ, where the symptoms have not existed for many hours, but have, in spite of their short duration, attained a degree of extreme severity, the taxis had better not be applied. The patient's condition indicates a vigorous strangulation, and the possibility that such strangulation may be overcome by pressure is overbalanced by the still greater probability that the bowel will be seriously damaged by the manipulation. Thus, in the case of very acute strangulation, involving a congenital inguinal rupture in a young lad, an anæsthetic should be at once administered, and if the gut be not reduced by a brief and gentle attempt at taxis, kelotomy should be performed without delay.

Taxis may be tried in cases that come under the surgeon's notice within a short time of the appearance of the symptoms, and in instances of longer standing where the local and general manifestations are but slightly marked. It should never be forcible nor long persisted in, and it would appear that the tendency of modern surgery is to regard this mode of treatment with considerable caution and some little doubt. In all cases, except where the hernia is seen immediately after it has become strangulated, the taxis should be applied under an anæsthetic. Anæsthesia places the patient in a condition most favourable for successful taxis, and reduces to a minimum the amount of force required to effect a reduction.

In any instance where taxis fails, or where it is considered inadmissible, kelotomy must be performed without delay.

Herniotomy or Kelotomy.—The precise incisions required in this operation are detailed in the accounts of the various anatomical forms of hernia. The tissues between the skin and the sac are divided layer by layer, and the outer wall of the sac is exposed. The recognition of the sac is often a matter of difficulty. In recent and uncomplicated strangulated herniæ, the sac is covered by a thin layer of loose cellular tissue devoid of fat. It has a bluish appearance, and all the characters of a thin-walled cyst, containing a darkish fluid. In ruptures of long standing, and in such as have been inflamed or have been unduly compressed by an ill-adjusted truss, or have been subjected to violent taxis, the sac-wall may present a very different aspect. It may be thick, pale, dense, and fibrous; or thick in one part and thinned in another. Its surface may be irregular, of a dark red colour, and so thickened that it may be readily mistaken for strangulated omentum. It may be closely bound down to the surrounding tissues, so that the finger cannot be passed about it. If the sac is to be opened, a part of its wall should be pinched up with the finger and thumb so as to insure its freedom at that spot from adhesions to its contents, and a small portion of the wall so examined being then seized with dissecting-forceps, the sac is opened. The opening of the sac is indicated by an escape of fluid.

There are certain fallacies which may occur, however, in connection with the opening of the sac. In the first place there may be no sac at all, or but a partial one. As a very rare condition there may be no fluid in the sac, or so little that its escape is not noticed. On the other hand a cyst may be found in front of the sac which, on being opened, may allow of the escape of fluid. Such cysts are usually bursal, and are developed in the connective tissue of the part as the result of the pressure of the truss. Cysts of the spermatic cord, when associated with hernia, are found behind the sac. In certain instances the sac-wall may be so closely adherent to the contents—especially to omentum—that the cavity of the sac cannot be demonstrated, and on continuing the dissection under such circumstances, the bowel has been opened.

If, when the sac is exposed, the tissues immediately outside its neck, which form indeed the hernial ring, be divided in part, the gut may often be reduced without the sac having been opened. Much has been written as to the question whether the sac should or should not be opened. The question is of little moment at the present day. The serious objection urged against the opening of the sac has been that it implied an opening of the peritoneal cavity. Since, however, the application of antiseptic principles to the dressing of wounds, this objection has ceased to have weight. If the sac be not opened, there is risk that the bowel may be reduced into the abdomen still strangulated, or in a condition of gangrene, or in a state of actual rupture or perforation. It must be confessed that these risks outweigh the risks which may be considered to attend the opening of the great serous cavity. It is by no means needful, however, that the sac should be opened as a matter of routine. If the rupture be still irreducible when the parts about the hernial ring have been divided, the sac must of course be opened. It should also be opened in any case when the rupture has been long strangulated, when the strangulation has been very acute, when violent taxis has been employed, and when the parts show evidence of inflammation. In any case of doubt, also, the sac should be opened. If the surgeon has resolved upon opening the sac, then it should be done before dividing the stricturing tissues outside the neck. If the stricture be divided, a piece of ruptured or perforated bowel may slip back into the abdomen before the sac has been opened. In any case where the hernia is very small—as in Littre's hernia and small femoral ruptures—the sac should be opened before the stricture is divided. If this precaution be not taken, the loop—which may be perforated—may slip out of reach into the abdomen. In ruptures that have always been readily reduced, or that are recent and are attended by strangulation-symptoms of slight degree and moderate duration, the reduction may be effected without opening the sac. In very large scrotal herniæ, the opening of the sac involves a special element of danger, in that it exposes a large amount of intestine to the ill-effects of cold, the irritation of sponging, &c., and much manipulation.

When the sac has been opened, and the fluid it contains allowed to escape, the contents must be carefully examined. Their treatment involves much consideration. If the gut be not too seriously damaged, the constrictions which retain it in position must be divided, and the piece of intestine returned into the abdomen. The constriction may either exist in the tissues outside the neck of the sac, or may be found in the neck itself; and in some cases a division of the narrowed parts, in both of these situations, may be needed to insure reduction. The stricture must be divided upon a hernia director by means of a hernia knife, or a suitable, protected bistoury. Care must be taken when the stricture is being divided, that no part of the distended bowel overlaps the edge of the director, and comes in contact with the edge of the knife. When the stricture has been partially divided, it is better to use the forefinger in place of the director. A forcible dilatation of the stricture, with the finger, is inadvisable and likely to cause damage to the bowel.

The state of the bowel can be better judged from its consistence than its colour. So long as the gut appears sound externally, and feels firm and resilient to the touch, it may be safely reduced. When it yields to the finger, and feels soft and flabby, it will most probably be too seriously damaged to be reduced. The colour of the loop alone is no true test of its condition. The surface of the gut is often dull and sticky from peritonitis. This condition is in itself no bar to reduction, but it should be noted that such a loop, after reduction, will probably acquire adhesions to some part of the serous lining of the abdomen. Flakes of lymph, upon the surface of the gut, should not be disturbed if the gut seems generally in fair condition, since they often hide minute perforations. If the bowel be gangrenous or ruptured, the whole portion involved should be well exposed and then resected; the part removed should include a little more of the intestine than the part actually gangrenous. An account of the methods of performing this operation is given under ENTERECTOMY.

When a pinhole perforation exists, it has been advised that the little aperture be closed by a ligature applied as one would apply it to the mouth of a bag, and that the loop be then reduced. Such a procedure is extremely hazardous. The gut about the perforation is possibly gangrenous, or, at least, not in a condition for repair; and the probability of sloughing of the ligatured part, after reduction, is not inconsiderable. In such a case, if the gut be gangrenous about the perforation, the dead segment should be excised. If its condition be doubtful, the loop should be fixed *in situ* by means of sutures that penetrate no deeper than the muscular coat. All constriction having been relieved, an artificial anus is established, which may be dealt with subsequently. If in any case the gut about the perforation appear really sound, then a minute elliptical portion of the bowel-wall may be excised, so as to include the fistulous aperture. The long axis of the ellipse should be parallel to the circular fibres. The margins of the wound should then be united by a deep and superficial set of sutures, and the loop returned into the abdomen.

When omentum is concerned, it should be reduced if its condition permits. If it be gangrenous or very difficult to reduce, or adherent, it should be removed. Its removal should be effected by clamping it just beyond the line of constriction, then excising it with scissors, and securing separately, by means of fine catgut sutures, such vessels as are divided. The cut end is then returned into the abdomen. The practice of including a mass of omentum in one ligature is strongly to be condemned. Equally to be condemned is the practice of leaving the divided or ligatured end of the omentum in the hernial orifice, so that it may form a plug. Omentum, thus rendered adherent, may form an 'omental band,' which may readily become, at some future time, a cause of internal strangulation.

Recent adhesions may be gently broken down with the finger. Old adhesions may be divided with scissors or torn across between two pairs of forceps. Bleeding from the divided ends may usually be arrested by forcible momentary compression of the part with a strong clamp, or, in the failure of this measure, by a touch with the thermo-cautery. In some cases, where large irreducible herniæ are concerned, the adhesions may be too numerous and extensive to be so treated. Under such circumstances, all constriction having been relieved, the gut must be left *in situ*, and protected—after the healing of the operation wound—by a suitable truss.

When the hernia has been reduced, the abdominal orifice of the sac should be closed. To effect this the attachments of the sac at and about its neck must be freed, so that the neck itself can be pulled down into the wound. It must then be encircled with a stout catgut ligature, which is tied in a firm knot. The ends of the ligature are cut off close to the knot. The treatment of the sac below the ligature permits of much difference of opinion. Some surgeons advise that it be left; others simply cut it across below the ligature, while others excise it entirely. In certain instances, as a species of compromise, a portion only of the sac below the ligature has been removed. In small and recent herniæ, and in herniæ that have not been the seat of inflammation of the sac, the separation of the sac, from the surrounding parts, is not difficult, the only obstacle indeed being the extreme thinness and delicacy of the membrane in recent ruptures. In femoral herniæ, the separation is, as a rule, readily effected. In inguinal ruptures there will be some difficulty in separating the sac from the cord, and this will be especially observed in the congenital forms. In dealing with sacs that have been the seat of inflammation in past times, the toughness of the walls, and the close adhesions that attach themselves to the surrounding tissues, may render the placing of a ligature about the neck of the sac or the excision of the membrane a matter of much difficulty.

As a general rule, it may be said, that when the hernia is of small or moderate size, the entire sac should be excised. In very large ruptures, however, such excision would involve an extensive wound and a tedious dissection; and in these cases, after the neck has been ligatured, the sac should be cut across below the ligature and its cavity well drained.

By the obliteration of the sac, the peritoneal cavity is closed; any bleeding that may occur after the operation cannot take place into that cavity, there is no trickling of serous fluid into the wound, and the hernia is kept up during the healing of the parts. In the case of small ruptures, the procedure may cause the hernia to be permanently retained, and in other cases it has led to such great improvement that the rupture has ceased to give the patient trouble, and has been supported by the lightest truss. From Leisrink's statistics, it would appear, that the rupture recurs in one-third of the cases so treated, while, according to Nussbaum, the hernia re-appears in nearly one half of the cases. Finally, the margins of the hernial orifice should be approximated, whenever practicable, by means of one or two sutures. The sutures may be of catgut or of silver, but the latter are to be preferred. In many cases these sutures are permanently retained. *See* HERNIA, Radical Cure of.

The superficial incision may now be closed. A drainage-tube should be inserted, which, in cases where an antiseptic dressing is used, may be removed at the end of twenty-four or thirty-six hours. Firm pressure, by means of pads and bandages, must be applied to the part during the healing of the wound. After the operation, the patient must retain the recumbent position; and in cases where the hernia has occupied any of the orifices about the groin, the thighs should be slightly flexed by means of a pillow placed beneath the knees. No food of any kind should be given by the mouth for twenty-four hours, nor until all sickness, due to the anæsthetic, has ceased. Ice to allay thirst should alone be given. Food excites peristaltic movements, and such movements are undesirable in a segment of intestine that has just been reduced from a hernia. Indeed, for twenty-four or forty-eight hours after the operation, all peristaltic movements should be checked by means of small hypodermic injections of morphia, or, if the patient be not sick, by opium or chlorodyne taken by the mouth. By the use of opium the parts are placed in a condition of perfect rest. The roughly handled or harshly strangled loop of gut can lie quiet and still within the abdomen, and can recover itself at its leisure. The bowels may be allowed to act spontaneously; but if they have not been opened for seven days after the operation, and the patient be in other respects well, an enema should be administered, followed by a dose of castor-oil.

Sequelæ of the Operation.—There are cases where, after successful taxis or successful reduction by kelotomy, the symptoms of obstruction in the bowel persist and lead to death. In such instances the following conditions have been found:—(1) A strangulation of the bowel exists elsewhere, either at a hernial orifice or within the abdomen. (2) The reduced gut lies within the abdomen *hors de combat* and paralysed, and, in such instances, death has followed without the gut having become gangrenous, and without peritonitis having followed. If such a condition be suspected upon fairly good grounds, laparotomy should be performed, and an artificial anus formed in the damaged loop. (3) The gut, which was in a critical state when reduced, has become gangrenous, or it has become so twisted upon itself as to be occluded. (4) Acute peritonitis has set in. In such a case the constipation persists, the vomiting continues, although it may be less frequent and less severe; the pain increases, and is more constant and more diffused; there is general and extreme tenderness; all peristaltic movements cease; the paralysed bowel is distended, and meteorism appears; the temperature usually rises, and the pulse becomes more rapid and more thready. The peritonitis may be due to extension of the mischief from the damaged loop, or may be due to perforation of the bowel, or to the entrance of septic matter into the peritoneal cavity during the operation. FREDERICK TREVES.

HERNIA TESTIS.—By this term is signified a protrusion of the testicle through an opening in the scrotum, due to inflammation of the gland. It is also known as benign 'fungus testis,' and 'granular disease' of the testicle. It has nothing in common with malignant fungus of the testicle, or 'fungus hæmatodes,' which is a protrusion of a malignant tumour of the organ.

1. *Causes.*—The most common causes are syphilitic and tubercular orchitis. Injuries and malaria may lead to chronic orchitis, ending in hernia testis, and very occasionally an acute orchitis leads to suppuration of the testicle and a hernial protrusion. Another form of hernia testis, due to a growth of granulations from the outer surface of the organ, is met with as a sequel of hydrocele, hæmatocele, or pyocele treated by incision of the tunica vaginalis.

2. *Pathology.*—For the pathology of the diseases terminating in hernia testis, *see* TESTIS, Diseases of the; HYDROCELE. It is usually the gummatous form of syphilitic orchitis that leads to hernia. One or more of the gummatous masses in the gland undergoes disintegration, the two layers of the tunica vaginalis over the gumma become adherent, and the superficial tissues of the scrotum inflame and ulcerate, discharging a certain amount of purulent débris and the detritus of the disintegrated gumma. The peripheral part of the gumma then protrudes from the opening in the skin. This may be sloughy in appearance and gradually soften down, or may consist of small pink nodules of seminal tubules with intervening masses of granulation-tissue; as the process subsides, the whole surface may be covered with granulations. The protrusion may consist of a great portion, or even the whole, of the testicle, and the tunica albuginea may be itself everted through the opening in the skin. In some rare instances the affection begins as a syphilitic tubercle in the skin, which gradually enlarges towards the testicle, and then involves that organ, and at last softens down; this is just the reverse of the usual course of events, so far as the order in which the tissues are affected is concerned.

The tubercular disease occurs in the epididymis alone, or in that and the posterior part of the body of the testicle. The exuded material undergoes caseation, and the caseous masses soften down into abscesses. Over these abscesses the superficial tissues become adherent, inflamed, and ulcerated, and the abscesses discharge externally; the caseous or infiltrated walls of these abscesses may then protrude through the orifice in the skin. Where acute orchitis terminates in hernia testis, it is by the formation of an abscess in the gland, which gradually enlarges towards the surface, and bursts externally; the infiltrated tissue forming the wall of the abscess then fungates through the sinus.

In cases of incision into the tunica vaginalis for the cure of hydrocele, hæmatocele, or pyocele, a growth of granulation-tissue from the visceral layer of this serous membrane may take place, and the granulations may at length project beyond the skin-wound. This form is known as *superficial hernia testis.* Where the wound in the scrotum is large, the contraction of the dartos favours the production of this form of hernia.

3. *Symptoms and Diagnosis.*—The symptoms common to all varieties are an ulcer in the scrotum, to the floor of which the testicle is felt to be adherent, and from which a pinkish grey or dull-grey soft fungus projects. The hernia varies greatly in size, and may be so large that but little, if indeed any, of the testicle can be felt within the scrotum. The edge of the ulcer is often thickened, everted, and puckered in, and it is more or less firmly adherent to the subjacent testicle. If the hernia be large, it overlaps the edge of skin, being shaped like a mushroom. The discharge from the sore is pus or sero-pus, and in some cases contains spermatozoa; hæmorrhage is rare, and only slight in amount. The protrusion is soft and yielding to pressure, which may elicit the peculiar testicular sensation. By these signs this disease is readily distinguished from a mere fungating ulcer of the scrotum on the one hand, and a malignant fungus of the testicle on the other. The latter is characterised by the presence of a large, rapidly growing, tumour of the testicle, by an entire loss of the testicular sense, by the livid colour of the protruding mass, and by the frequent profuse hæmor-

rhages from the fungus; also by the enlargement of the cord and the implication of the inguinal or iliac glands. To distinguish between the varieties of benign fungus, the following points must be carefully noted: the history, the part of the testicle affected, the condition of the cord, prostate, and seminal vesicles, and the character of the discharge.

Syphilitic fungus testis is a chronic affection occurring in the tertiary period of the disease; it may be met with in young children. The body of the testicle is alone or chiefly affected; the cord is slightly, if at all, enlarged, and the prostate and seminal vesicles are not enlarged; the discharge may contain spermatozoa. Tubercular fungus testis is also a chronic disease, in which the epididymis is alone or chiefly affected, and the sore is at the back or outer side of the scrotum. The discharge is stated never to contain spermatozoa. The cord is enlarged, and there is very often nodular enlargement of the prostate and seminal vesicle, and signs of tubercular disease of the lungs, kidneys, or bladder; there may or may not be an entire absence of all history of syphilis. The history of the acute onset and rapid progress of the disease distinguishes the rare cases arising from acute suppuration in the testicle. The discharge may contain spermatozoa. The superficial form of hernia testis is recognised by the history of a previous incision into the tunica vaginalis, by the slight amount of fungous protrusion, by the normal or, more usually, enlarged size of the testicle within the scrotum, and oftentimes by the appearance of the granulating surface. The discharge never contains spermatozoa.

4. *Treatment.*—Hernia testis is a curable affection, and the aim of the surgeon is to close up the superficial wound over the protruding mass as quickly as possible. At the same time, the disease which has led to the fungus must be energetically treated. When due to syphilis, the system should be brought under the influence of mercury or iodide of potassium. Where the patient has already been subjected to a thorough course of mercury, iodide of potassium may be given; but where this is not the case, mercury should be given, alone or combined with the iodide. The fungus may be dressed with powdered iodoform, or iodide of starch paste, or unguentum hydrargyri; and then careful compression should be exerted upon the fungus by means of a dossil of lint placed over it, and fixed by strapping brought round the scrotum and crossed over the lint. If the edges of the skin are very adherent and indurated, they may be carefully detached from the subjacent parts, and the above treatment continued. Syme's operation of dissecting up the skin on each side and uniting it over the hernia is usually unsuccessful. When the whole testicle is evidently entirely disorganised, it should be excised; but this operation should not be hastily done, as with patience and perseverance in the treatment recommended, even severe cases may recover, with a more or less useful organ. Where the disease is tubercular, the same local treatment should be carried out, iodoform being the best application to the sore. Internally, cod-liver oil, iron and quinine, combined with good food and residence by the sea, will be indicated. In some cases, where the whole testicle is disorganised, and the disease is still limited to the one organ, castration is clearly indicated. Even where other organs are diseased this may be the best treatment, as causing less drain upon the feeble powers of the patient than discharging sinuses. When the result of acute orchitis, the patient should be kept at rest, and the part should be carefully cleansed and dressed with iodoform or some other unirritating antiseptic agent, and compression applied as in the other cases. The same treatment is applicable to the cases of superficial hernia testis; castration should not be performed.

A. PEARCE GOULD.

HERNIA, Varieties of. *See* FEMORAL, INGUINAL HERNIA, &c.

HERPES.—An acute inflammatory affection of the skin, characterised by one or more groups of vesicles running a definite course.

HERPES FACIALIS (*Synon.* H. labialis, H. catarrhalis) may accompany slight indisposition of a febrile character (catarrh), or it may occur in the course of severe febrile diseases, pleurisy, pneumonia, typhoid, ague.

Symptoms.—The lips, alæ of nose, more rarely the cheeks, chin, or ears are at first affected by hot œdematous patches of skin, accompanied by a burning or smarting sensation. Soon a crop of pin-head or pea-sized vesicles appear, which, if not interfered with, dry up and fall off at the end of about a week, no scars remaining. When the affection occurs on the lips, the mucous membrane of the inside of the mouth is liable to be affected; here, in consequence of the maceration of the saliva, the epithelium is soon shed from the vesicles, leaving red excoriations. Herpes facialis is prone to recur, especially in certain individuals.

HERPES PROGENITALIS (*Synon.* H. preputii).

Cause.—The disease differs little from Herpes facialis, and is said to occur in individuals who have been previously attacked by gonorrhœa or syphilis. In some individuals it occasionally follows coitus, in others it invariably does.

Symptoms.—In the male, the prepuce, inner or outer surface, glans, and balano-preputial sulcus are the parts affected; in the female, the labia minora, majora, and adjacent skin. The eruption is similar to that described under H. facialis; only three or four vesicles are usually present; it may be preceded by itching or neuralgic pain. It has been supposed that these neuralgic cases are more allied to H. zoster.

Diagnosis.—When occurring on a mucous surface (inner prepuce, labia minora) the lesions are soon converted into superficial excoriations, covered with a pus-secreting membrane. In this state they may be confounded with a soft sore. The lapse of a few days is sufficient to settle doubt, herpes running a definite short course.

Exposure to infection during an attack of herpes suggests a guarded prognosis, as the lesions may eventually become the seat of an indurated sore and lead to constitutional syphilis.

Treatment.—This need only be local. See *Herpes Zoster* treatment.

HERPES CIRCINATUS, an old term for ringworm.

HERPES IRIS (*Synon.* Hydroa), *see* ERYTHEMA.

HERPES ZOSTER (*Synon.* Zona, Zoster, Shingles).

Cause.—An inflammation of the nerve-trunks or ganglia. In some instances this has been shown to be due to traumatic influences, wounds, surgical operations, strain, &c., or to the spread of inflammation from neighbouring growths, &c. In the vast majority of idiopathic cases the cause of this inflammation is obscure. Malaria, cold, damp, have been suggested. Lately it has been shown that patients taking arsenic are peculiarly liable to herpes zoster. Considering the number of individuals who must be exposed to the causes of herpes zoster, and its comparatively rare occurrence, it seems probable that the disease depends upon some personal peculiarity or idiosyncrasy. The affection very rarely recurs.

Pathology.—The inflammatory changes which have been found in the ganglia and nerve-trunks are hyperæmia, cell-infiltration, extravasation of blood, with softening and destruction of the nerve-fibres. The irritation of the inflamed sensory nerve is determined to its peripheral distribution, setting up the peculiar eruption on the skin which has been conjectured to be caused by inflammation of the special nerve-endings (bulbs, &c.) of the cutaneous nerves. The cutaneous lesions early affect the deeper cells of the Malpighian layer—the inflammatory exudation, serum or pus, finally elevating the more superficial layers of the epidermis, and giving rise to the formation of vesicles.

The proximity of the inflammation to the papillæ cutis accounts for the frequent destruction of the latter and the resulting loss of substance.

Symptoms.— The eruption manifests itself at first as hot, erythematous patches, distributed in the course of the cutaneous branches of some cerebral or spinal nerve. Within a few hours papules or minute vesicles are recognisable on the patches. The vesicles rapidly attain their full development; and at the end of four or five days the patch has assumed the typical appearance about to be described. During the first few days fresh patches may continue to crop up, prolonging the climax of the disease to about a week or ten days. At this stage the disease takes the form of clusters of vesicles situated on inflamed patches of skin. The vesicles are mostly lentil or pea-sized, tense, somewhat flat, overhanging their bases; they are filled with a serous or sero-purulent fluid, according to their stage of maturation; not infrequently their contents are purplish from admixture with blood. The vesicles are thickly scattered towards the centre of the patches, where they are liable to coalesce into flat, irregularly-shaped blisters or bullæ. This central group of vesicles is often surrounded by other outlying and similar groups, giving to the whole patch a clustered, or, as it has been termed, corymbose appearance. Having attained its full development, the eruption rapidly declines, the redness subsides, the pus desiccates into yellowish-brown scabs which fall off in a few days; so that usually by the end of a fortnight or three weeks all that remains of the eruption are a few discolorations of the skin, with or without accompanying scars.

The eruption is liable to certain modifications. (*a*) It may abort; the redness may appear, but rapidly subside again, leaving a few scattered pin-head vesicles, which rapidly desiccate. This is specially liable to occur in the remote distribution of the nerve, so that in a case of zoster pectoralis, while typical patches are seen near the spinal groove, the patch corresponding to the anterior branch of the nerve may be abortive. (*b*) Sometimes spontaneously, more often as a result of friction (clothing, &c.), the vesicles are ruptured. Crusts form, and if the irritation is continued the vesicles become the seat of sloughy sores, with more or less infiltrated bases, leading to extensive loss of substance. Names are encountered indicating the region attacked—e.g. Zoster frontalis, Z. nuchæ, Z. brachialis, Z. femoralis, &c. The disease is almost always unilateral, but a few cases of bilateral herpes are recorded. This unilateral distribution of the disease assists the diagnosis, the eruption stopping almost abruptly at the middle line.

Pain is almost a constant symptom of herpes. It may precede, accompany, or succeed the eruption ; it may be trifling or severe, and quite out of proportion to the severity of the eruption. Children scarcely complain of it, but in adults it may be of a persistent, gnawing, neuralgic character, destroying rest. In old people it is liable to persist for months, seriously undermining the health.

Besides this essential neuralgic pain, the eruption itself gives rise to smarting and burning during its development.

Certain complications may arise in herpes. (*a*) Trophic disturbances. One of the most serious is the liability for the deeper structures of the eye to become involved in destructive inflammation in cases where the conjunctiva is affected in zoster frontalis. The teeth have been known to fall out in cases where the second division of the fifth has been affected. (*b*) Paralyses (temporary) have been known to precede or accompany the eruption. (*c*) Numbness of the part affected, more or less persistent, may follow the eruption.

Diagnosis.—H. Zoster is to be distinguished from (1) catarrhal herpes, an affection liable to occur about the orifices of the body, mouth, nose, genitals, &c. ; not accompanied by neuralgia nor following any nervous distribution, and recurring frequently in the same individual. Anatomically the two eruptions are similar.

(2) From eczema, an itching, not painful affection, characterised in its vesicular stage by small miliary vesicles, evenly and closely set, not running a definite course.

(3) From some vesico-pustular forms of secondary syphilitic eruptions, the grouped arrangement of which may give a superficial resemblance, but which can be recognised by their chance distribution, mode of evolution, and the presence of concomitant symptoms of syphilis.

The early neuralgia, preceding the eruption in zoster pectoralis, with the accompanying difficulty of breathing, has led to the mistaken diagnosis of incipient pleurisy.

Treatment. — Simple, uncomplicated cases of herpes zoster require little treatment ; all that is necessary being to warn the patient not to rupture or irritate the vesicles. The clothing should be loosened, and the eruption thoroughly dusted with a dusting powder—*e.g.* : ℞ Pulv. camph. ʒss. ; zinci oxidi, ʒiij. ; amyli ad ℥j. Absorbent cotton wool should be lightly bound over the part.

It may be necessary to relieve pain during the acute stage by opiates given internally, or by morphia injected subcutaneously ; the after-pain may require tonic treatment by quinine, iron, or arsenic. Phosphide of zinc (gr. $\frac{1}{3}$ every three hours), given at the commencement of the attack, is said to control the pain and abort the eruption (Bulkley).

A good plan for protecting the vesicles and relieving the pain locally is to paint on flexile collodion with morphia (gr. x.–f℥j). Glycerine and carbolic acid (1–8), painted on, relieves the smarting, especially if the vesicles be ruptured. In the early stages soothing lotions may be applied to relieve the burning sensations—e.g. lotio plumbi or linimentum calcis.

Duhring says the disease may be most advantageously treated by the constant current, applied directly to the seat of eruption and over the course of the nerves by sponge electrodes (five to ten cells), for fifteen to twenty minutes once or twice a day ; the pain and eruption are often arrested thereby. ALFRED SANGSTER.

HERPES FRONTALIS vel **OPHTHALMICUS**, from the frequency with which it is attended by inflammation of the conjunctiva, cornea, and iris, calls for the surgeon's special notice. It occurs in two forms, the simple and the neuralgic. In the latter, which is in all other respects also the graver, pain, more or less severe, may be felt in the area about to be attacked for days, or even for weeks, before the eruption appears. The parts commonly concerned are the supra-orbital region, the root and side of the nose, the brow, and the scalp —those parts, in fact, which are supplied by the ophthalmic division of the fifth nerve. The precise areas involved are those innervated by the supra-orbital, the infra- and the supra-trochlear, and the nasal branches, and, more rarely, that supplied by the lacrymal branch. In all respects the skin-eruption resembles that of herpes zoster (q.v.). About the time that the crusts of the dried vesicles are falling, inflammation of the conjunctiva and cornea may occur. The keratitis may go on to ulceration and, finally, perforation of the cornea. See *Neuropathic Keratitis* under CORNEA.

With or without the corneal complication, a chronic and obstinate form of serous iritis may occur, accompanied by increase of intra-ocular tension (pseudo-glaucoma), or true glaucoma itself may supervene. The eye is especially liable to be implicated if the nasal nerve have been involved (Hutchinson).

The *pathology* of herpes ophthalmicus is the same as that of herpes zoster. *See* HERPES. The pain and the skin-manifestation are neuropathic, and dependent upon irritative lesions in the Gasserian ganglion and other portions of the fifth nerve.

Diagnosis.—The disease is often mistaken for erysipelas. It may, however, be discriminated by observing its precise unilateral distribution, and the character, site, and mode of grouping of the vesicles, which are situated along the course of the affected nerves, or about their terminations.

Treatment must be local and general. *Local* treatment consists in protecting the skin, and applying soothing and absorbent powders, as oxide of zinc, calamine, starch, &c. If the conjunctiva, cornea, or iris be implicated, a drop of a solution of atropine should be applied once or twice a day, and the eyelids must be kept closed and scrupulously clean. The conjunctival sac may be gently washed once or twice a day with a solution of boracic acid (gr. iv. ad f℥j.), or sulphate of quinine (gr. iv. ad f℥j.). In addition, the lids should be covered by means of a well-fitting compress, on which a layer of boracic acid ointment (gr. xx. ad ℥j.) has been spread, so as effectually to exclude both air and light. The compress should be kept gently but firmly applied by means of a light bandage. In very severe cases, immediate and permanent relief may be obtained by paring the edges of the lids and stitching them together. Not only does the pain at once abate, but the ulcerative process is checked, and repair takes place. The lids should be kept closed, and protected from dust, air, and wind, until pain and all other signs of inflammation have entirely disappeared. This may not take place for two, three, or four weeks, or even longer. When repair is complete the lids may be separated, and the eye gradually accustomed to exposure. At first tinted or other protecting glasses should be worn out of doors or in a bright light.

For the *general* treatment see *Herpes Zoster* under HERPES. J. TWEEDY.

HEY'S AMPUTATION. *See* FOOT, Amputations in the.

HIP, Diagnosis of Diseases and Injuries about the.—The hip-joint lies everywhere under muscular cover, and is in consequence but little open to direct examination. The position of the great trochanter, which can be readily felt, thus becomes of importance as indicating, when displaced with the shaft, an alteration in the normal position of the head of the bone or a separation of the neck of the femur. There are two positions, however, where, by firm pressure, some indication is obtained of the condition of the hip-joint. The first of these is a little below Poupart's ligament, where the joint is crossed by the psoas, iliacus, and pectineus muscles. By extension and rotation outwards, the head of the bone may be thrown up beneath these muscles, and on flexion a slight hollow appears over the position of the joint. The other spot is the hollow behind the great trochanter. Tenderness and fulness may be often detected in these situations when there is inflammation of the joint.

If a healthy person be placed in the prone position, with his legs extended and parallel, the gluteal folds between the buttocks and thighs form a right-angled cross with the vertical interval between the thighs, and its continuation upwards between the buttocks. In hip-disease, the fold of the affected side becomes lowered in position and lessened in depth. This change is brought about by semi-flexion of the thigh and wasting of the gluteal muscles.

Rigidity of the muscles about the hip is an important sign of disease of the joint, especially in children. Normally, the knee may be so flexed as to touch the abdomen without pain, but in hip-disease the motion of the thigh becomes arrested long before this position is reached. On the other hand, if the leg and thigh be straightened so as to lie flat on a couch, the lumbar spine will rise in a curve, indicating that the hip-joint will not admit of full extension. In addition to flexion some adduction takes place, and the writer has pointed out in the Clinical Society's Transactions for 1881 that, as a result of double hip-joint disease, a peculiar deformity may result, whereby one leg is fixed across the other, and the patient walks from his knees instead of from his hips. This he described under the name 'cross-legged progression,' or 'scissor-leg deformity.'

Muscular rigidity will enable the surgeon to distinguish *hip-disease* from *neuralgia* or *sciatica*; but, should he trust too much to this sign, he may overlook disease of the spine and treat it as of the hip-joint, for an abscess, burrowing in the psoas or passing through the sciatic notch, will cause pain and consequent limitation of the movements of the hip. Rigidity, tenderness, and prominence of some part of the spine would tend to clear up the case; but *spinal disease* and hip-disease may co-exist. Semiflexion and limitation of movement may be also caused by *cellulitis in the iliac fossa*, resulting from perityphlitis or spreading from the uterus. In this case resistance above Poupart's ligament will be detected on pressure, and in gentle rotatory movements the hip-joint will be felt to move smoothly.

Osteo-arthritis, affecting the hip-joint, may be generally distinguished by its occurring in the middle or late period of life, its chronicity without tendency to suppuration, the creaking movements, and the occurrence of outgrowths about the trochanter, neck, and acetabulum, which in the later stages may be felt. *Charcot's joint-disease*, which is associated with locomotor ataxy, may cause rapid destruction of the hip, resulting in dislocation without suppuration. Its onset is usually sudden, though little painful, and it is often associated with much swelling of the soft parts, so that it has been mistaken for malignant growth. In its late stages its tendency is towards atrophy of bone and looseness of capsule, whereas the tendency in osteo-arthritis is towards hypertrophic outgrowths, and consequent fixation of the joint. *See* CHARCOT'S DISEASE.

Lameness due to *sacro-iliac disease* may be distinguished from that due to morbus coxæ by proving the movements of the hip to be free, by the pain excited on pressing together the iliac crests, and by the swelling and tenderness usually evident over the affected joint. *Inflammation of the bursa* between the gluteus maximus and great trochanter may obscure the outline of this process. The bursa may be evident in three forms—(1) as a fluctuating swelling due to serous effusion; (2) as a firm tumour due to fibrous deposit in its interior; (3) in a state of suppuration, when there will be tenderness, enlargement of the superficial veins, and a tendency to œdema of the cellular tissue over it. *Sciatic hernia* or an *abscess passing through the sciatic foramen* may cause a tumour at the lower margin of the gluteus maximus, and either may yield impulse on coughing; but the latter will be found associated with disease of the pelvis or spine, and the signs of inflammation will be gradually developed. Hernia, if reducible, passes back suddenly, and often with a gurgle.

If loss of movement and deformity about the hip result from *injury*, a fracture or dislocation is to be suspected. It is thus of great importance to compare accurately one limb with the other. Skilled hands will determine sufficiently the relative positions of the trochanters and iliac crests on the two sides, by placing the thumbs on the anterior superior spines and the fingers over the trochanters. For more exact observation, 'Nélaton's line' is of great assistance. This is a line drawn by a tape or string from the anterior superior spine to the most prominent part of the ischial tuberosity, and its value rests on the fact that it just skirts the upper edge of the great trochanter; consequently, any alteration in the normal position of this process is readily detected. The trochanter is raised above this line in cases of fracture of the neck of the femur, and in three out of the four regular dislocations of the hip-joint. Another way of measuring the elevation of the trochanter has been suggested by Bryant. When the patient is on his back he drops a perpendicular from the anterior superior spine of the ilium, and measures the distance between the trochanter and this vertical line. Shortening of the limb may also be determined by comparing the measurements between the anterior superior spine and the inner malleolus on either side. Forcible extension should not be made when taking this measurement, as, owing to tilting of the pelvis, the limb may thereby be actually shortened instead of being lengthened.

An injury resulting in shortening of the limb, with *eversion* of the foot and elevation of the trochanter, is probably a *fracture of the neck of the femur*. The only dislocation which causes well-marked eversion is the *superpubic*; in this case the head of the bone is felt in its abnormal position. If the injury were caused by a direct fall upon the trochanter, the fracture is probably *extra-capsular* and *impacted*.

The trochanter is widened, there is no crepitus, and the axis of rotation is through a shortened neck. If caused by abduction of the limb in an aged person, it is probably *intra-capsular* and *unimpacted*: the trochanter is normal, the axis of rotation is through the shaft, and crepitus may be elicited by extension and rotation.

When the injury results in shortening of the limb and fixation, with *inversion* of the foot and elevation of the trochanter, one of the two backward dislocations is present. In *superiliac* dislocation, the head of the bone may be felt on the dorsum, the trochanter is prominent, and the shortening considerable. In *supersciatic* dislocation, the shortening is slight, the inversion less marked, and the head of the bone not readily to be found from the outside, though sometimes to be felt in the sciatic notch by the finger passed into the rectum or vagina. In rare cases an extracapsular fracture of the neck is associated with inversion. The movements of the joint are then freer than in dislocation.

If the limb is apparently lengthened, and the trochanter lowered and buried, there is a *superthyroid* dislocation; the foot is then carried forwards and outwards, the body is bent over the thigh, and the adductors are tense.

Pathological and *congenital* dislocations usually take place on the dorsum ilii. A pathological dislocation is apt to become ankylosed in a flexed position, in consequence of which great bending forward of the lumbar spine, or *lordosis*, takes place when the foot is brought to the ground. Congenital dislocations also give rise to lordosis, and a waddling gait is usually noticed as soon as the child begins to walk.

R. Clement Lucas.

HIP, Excision of the. *See* Hip-disease.

HIP-DISEASE.—This term is applied to a chronic and often very insidious inflammation of the hip-joint, which, beginning either in the bones or in the synovial membrane, tends to pass on to suppuration and the production of deformity, and in many instances even to a fatal issue; but which, if efficiently treated in its early stage, may in most cases be repaired with little injury to the functions of the limb, and with no impairment of the general health.

By many authorities this affection is considered to be the result merely of neglected local injury, and to be unassociated with any constitutional defect, while by others it is looked upon as strumous or scrofulous. This question can be treated only very briefly in the present article, but it cannot be entirely passed over. The terms struma and scrofula are here taken to be synonymous, and are used to express a defective condition of the general health, with a tendency to various obstinate local inflammations tending to suppuration and caseation—as of lymphatic glands, cancellous bone, mucous and synovial membranes, and the skin. Although in many examples of struma as thus defined tubercle is present, in others no histological elements beyond those of mere chronic inflammation can be detected; and it is only when certain points in their natural history and clinical features are taken into account, that the ground for placing these affections in a distinct group becomes apparent. These points are their common association, in respect of inheritance, with tubercular phthisis; their occurrence in different members of the same family; the development, as we frequently see, of several of them in the same patient; their strong tendency to advance and relapse and to lead to suppuration; and their presence in cases from which the occurrence of local injury can be excluded—for instance, when disease of one of the large joints comes on in a patient who has been in bed for several months for the treatment of spinal caries. These characteristics are so well-marked in a large number of instances of hip-disease that, while many cases may be fairly attributed to mere local injury in patients who are otherwise healthy, the affection, even though originating in an injury, must, speaking generally, be regarded as owing its subsequent progressive tendency to the strumous diathesis. This question, however, is not of so much clinical importance as at first sight it appears to be; for the strumous and the non-strumous cases alike must be treated—in the manner described below—by absolute rest of the joint itself, combined of course with all the means that are calculated to improve the general health. The mistake formerly committed lay in maintaining that, as the disease is often strumous, or, in other words, constitutional, the chief point in treatment must be to provide exercise in the open air, and to regard local measures as of merely secondary importance. It is to this fundamental error in the treatment of this affection that the disastrous results which were formerly so common must be attributed.

Hip-disease, like other affections of the strumous group, although it may be met with at any age up to puberty, or even later, is much more prevalent in early childhood, and commences in a large proportion of cases between the ages of three and seven years. The affection most commonly begins in the bones—either in the head or neck of the femur, or in the acetabulum. It may, however, take its origin in the synovial membrane. The view formerly entertained, that it commenced in the ligamentum teres, or in the cartilage, has been discarded. In the upper end of the femur its starting point is the cancellous tissue just beneath the cartilage, or the line of junction of the epiphysis with the shaft. It may also commence, in more rare instances, in the neighbourhood of the ossific nucleus of the head, or in some part of the neck within the capsular ligament. In the acetabulum, the inflammatory process commonly attacks the line of junction between the three segments of bone which meet in the floor of this cavity. The synovial form may be so acute as to lead to early suppuration, tending to run on to disorganisation of the joint; or it may be chronic and persistent, and attended with the slow formation of matter, or the effusion of plastic lymph, leading to fibrous or bony ankylosis.

In whichever way it commences, the disease, unless it is arrested by treatment, soon involves all the soft structures of the joint, and frequently also both the upper end of the femur and the acetabulum, so that a general arthritis, attended in the great majority of instances with suppuration, is established. As the bones forming the joint are cancellous in structure, the inflammatory process commonly ends in caries rather than in necrosis. Even when necrosis has taken place the sequestra are seldom large enough to be important, and consist of soft fragments, easily broken down and carried away in the discharge. Sometimes, however, in consequence of acute inflammation in the line of junction of the head with the neck of the femur, the whole head, or what remains of it, may become separated from the rest of the bone and form a large loose sequestrum. In the later stages of the disease, the bones, including the upper border of the acetabulum, are extensively absorbed, and the upper end of the femur—though generally remaining in the eroded and enlarged acetabular cavity—is drawn, by the muscles inserted into it, upwards and backwards towards the dorsum ilii. In cases in which the strumous diathesis is very pronounced, chronic inflammation may spread widely in the medullary tissue of the femur, or may lead to the destruction of the whole floor of the acetabulum and the adjacent parts of the pelvis.

Diagnosis.—The recognition of hip-disease in its advanced stage is generally a very simple matter; but this is by no means the case when the affection is still incipient, for the various symptoms are then often but very slightly marked, and, moreover, nearly all the signs of early hip-disease are also the signs of other affections either of the lower limb or of the spinal column. A diagnosis, therefore, can often be arrived at only by a careful study of many slight symptoms, any one of which, taken alone, would be either deceptive or altogether inconclusive. These symptoms, to take them in the order in which they may be most conveniently observed in the examination of a patient, are—

(*a*) *Lameness.*—This condition is always present, though it is often so slight that it may easily escape notice. It may depend either on pain, or on a fixed or distorted position of the limb; but as the sensitiveness of the joint varies in different cases, and as the position of the limb varies in different instances, there is no form of lameness that is at all characteristic of hip-disease, and the symptom is valuable only so far as showing that the patient is unsound, and as calling for further investigation of the case.

(*b*) *Pain.*—The degree to which pain is developed is very variable. In some instances it is so slight, or even so entirely absent, that the disease is not suspected. In others it is from the first very severe. It may be limited to the joint itself, but very often it is referred to those situations lower in the limb to which the peripheries of the obturator and anterior crural nerves, which send offsets to the joint, are distributed—that is, to the knee, or in rarer instances to the middle of the inner part of the thigh or the inner side of the leg. It must, however, be borne in mind that pain is referred to these situations, not only in hip-disease, but also in such widely different affections as disease of the lumbar spine and of the sacro-iliac joint, cancer of the rectum as related by Mr. Hilton, and abscess and aneurism in Scarpa's triangle; every case must, therefore, be thoroughly investigated, so that the real source of the pain thus referred may be ascertained.

(*c*) *Altered Position of the Limb.*—In the early stage of the disease the joint, in a typical case, becomes flexed, abducted, and rotated outwards. The explanation of this position of the limb has been much discussed; it is, however, very simple. The posture is merely that of 'greatest ease,' and is the same as that into which the joint is unconsciously brought when a person sits down with the limbs flexed on the trunk, the knees slightly apart, and the heels touching. It secures the relaxation of all the ligamentous structures of the joint: flexion relaxing the front of the capsule, abduction relaxing the ligamentum teres and the strong outer (ilio-trochanteric) band of the ilio-femoral ligament, and rotation outwards relaxing the inner band of the same ligament and also the back of the capsule. At a later stage the adductors, the most powerful group of muscles around the joint, stimulated to contraction by reflex irritation, gradually draw the limb inwards, so that, instead of being flexed and abducted it now becomes flexed and adducted. Shortening due to absorption of bone commonly takes place at this period, and is indicated by the shifting of the trochanter upwards, or upwards and backwards, in the acetabulum enlarged by the absorption of its upper border. This displacement may be detected by observing that the apex of the trochanter lies above Nélaton's line, drawn from the anterior superior iliac spine to the most prominent part of the tuber ischii. In advanced cases real shortening is often in part due to arrested growth of the limb. Real lengthening, if it ever occurs, is certainly in the highest degree rare. The writer has never seen it demonstrated. Apparent lengthening arises when, the limb being abducted and fixed, the patient wheels it inwards till it is parallel with its fellow, by drawing up the opposite side of the pelvis; while apparent shortening results when, the limb being adducted, the patient wheels it outwards by drawing up the pelvis on the affected side.

(*d*) *Loss of Movement in the Joint.*—This is the most constant and the most conclusive symptom. Cases of hip-disease in which movement is absolutely unimpaired are so rare, that the presence of completely free movement may in itself be taken as all but absolute proof that the joint is sound. It should be remembered, however, that the loss of flexion and extension of the thigh on the trunk is a symptom by no means limited to hip-disease; in psoas and iliac abscess the thigh generally cannot be fully extended; in abscess under the glutei it cannot be fully flexed; it is, therefore, necessary not only to test flexion and extension, but to see whether the ball-and-socket movement, or rotation of the femur in the acetabulum, is interfered with. If rotation is free, it may be concluded that the loss of either flexion or extension depends on some condition external to the joint; if, however, rotation is deficient, this fact will tend to show that the joint itself is affected. This test as to the various movements of the thigh on the trunk must be very gently carried out. If the examination is roughly made, all the muscles will be contracted to protect the joint, and this contraction will be mistaken for rigidity resulting from disease.

(*e*) *Muscular wasting* is a very constant symptom. It is most marked as flattening of the glutei and obliteration of the fold between the nates and the thigh; but it can also be detected, with less annoyance to the patient, by comparing the measurement around the middle of the thigh with that at the same level of the opposite limb. Muscular wasting is often ascribed to non-use of the limb; it is, however, in great part dependent on reflex atrophy, and has its counterpart in the muscular wasting which accompanies disease of all the principal joints.

(*f*) *Swelling.*—This is often absent during the earlier stages of the disease. At later periods it may make its appearance either in front of the joint in Scarpa's triangle, or behind the trochanter, or on the outer aspect of the limb beneath the tensor fasciæ femoris, or in the form of general brawny thickening around the articulation.

During examination, a patient suspected of having hip-disease should be undressed and placed, not on a soft bed, but on a firm mattress or couch, so that the outline of the spine and limb may be clearly ascertained. It must be noticed whether, while the ham touches the couch, the lumbar spine is free from anterior curvature (lordosis); whether the heels correspond; and whether the anterior iliac spines occupy corresponding positions. If, when the limb is down upon the couch, the spine is arched forwards, this is evidence that the thigh is flexed upon the pelvis. The extent of this flexion can be defined by raising the limb till the spinal curvature is removed. If the iliac spine on the suspected side is lower than that on the opposite side, it shows that the limb is abducted—to what extent may be ascertained by moving the limb outwards till the two spines are again level; while if the iliac spine on the suspected side is, on the contrary, drawn up, it indicates adduction, the amount of which may be determined by moving the limb inwards across its fellow till the pelvis is again square. In this manner the real position of the limb on the trunk will be ascertained. Motion should now be tested by carrying the thigh slowly and gently in a direction first of flexion and then of extension, the hand being placed under the loin to see that the lumbar spine remains at rest. Next, the thigh should be carefully rotated to ascertain whether the femur turns freely in the acetabulum. These several movements must be carried to their full natural range; for, in slight cases, it is only when the extreme limits are approached that any stiffness can be detected. Muscular wasting should be investigated, either by observing whether or not there is any flattening of the gluteal region, or by comparing the circumference of the two thighs at the same level. If swelling is present it may be detected by comparing the two sides, or by passing the hand over the surface. Tenderness on pressure, either in front of the capsule or behind the trochanter, is sometimes noticed in cases in which other signs are but little marked; but, unless care is used, the pain of rough handling may be mistaken for the evidence of disease. Jarring of the heel or knee is not to be relied on; it is a test very likely to make a timid child flinch, although the joint is quite sound; while, on the other hand, there are many cases of hip-disease in which the jar produces no complaint of pain.

When these various symptoms have been investigated, the evidence obtained must be carefully weighed. As a rule it is easy to arrive at a definite conclusion; but in some cases the diagnosis can be formed only by combining a number of minor signs. Thus, in one case there is, together with an appreciable limitation of movement —which is, as has already been said, almost invariably present—some slight muscular wasting of the limb; in another, to slight stiffness are added slight apparent lengthening, pain on movement, and rigidity of the adductor longus or some of the other muscles around the joint. In another, with some loss of motion, there may be detected slight flexion, pain in the knee, and fulness in the groin. Negative evidence is sometimes of great value; for if, notwithstanding that the child is lame, has pain in his knee, and keeps his thigh constantly flexed on the pelvis, it is found that there is no stiffness at the joint, but that the head of the femur still moves freely in the acetabulum, it may be strongly suspected that the symptoms depend, not on disease of the hip, but on caries of the spine, or some other affection of the neighbouring parts, and a more extended examination must be made. The affections most likely to be mistaken for hip-disease are caries of the spine, attended with iliac or psoas abscess, or abscess burrowing down under the glutei; infantile paralysis; congenital dislocation of the hip-joint—a more common condition than is usually supposed; and, in young children, the lordosis of rickets, accompanied, as it may be, by a painful condition of the limbs, often present when rickets is acute.

When the disease is allowed to make progress, various complications are developed.

Deformity.—The limb, under the influence of the surrounding muscles, assumes positions which undergo some remarkable changes as the disease advances. At first the thigh becomes more flexed and more abducted—the latter posture being itself the cause of any apparent lengthening; but at a later stage, owing to the preponderating action of the adductors—the most powerful group of muscles around the joint—the limb becomes adducted, or, when the compensatory has been substituted for the real position, apparently shortened, by the drawing up of the pelvis on the affected side. By degrees also, and as the effect of constant intra-articular pressure resulting from muscular action, the joint surfaces are absorbed, and the trochanter travels upwards and backwards upon the ilium, and so considerable real shortening is produced.

Abscess.—In neglected cases suppuration is almost constantly met with, while, even when treatment has been resorted to in an early stage of the disease, abscess in a large number of instances sooner or later is developed. Matter usually forms slowly, so that the abscess is of the cold variety. But in some cases the suppurative process is acute, and attended with a high temperature, night screams, and pain on movement. The abscess is generally formed within the capsule, and subsequently makes its way outwards, either through the cotyloid notch, to reach the surface in Scarpa's triangle, or through the thin posterior part of the capsule, to appear beneath the glutei; or it may pass into the bursa under the tendon of the ilio-psoas (which frequently communicates with the joint), and present itself in the immediate neighbourhood of the femoral vessels. In some cases, however, the abscess is from the first external to the joint, and arises from suppuration among the inflammatory products with which the soft parts have been infiltrated. Such abscesses may appear at any aspect of the joint, though they are most commonly seated beneath the tensor fasciæ femoris, or further down on the outer side of the thigh. A formidable variety of abscess is that which is developed within the pelvis as the result of disease of the acetabulum, and which makes its way to the surface above Poupart's ligament. Suppuration within the pelvis may often be detected by a finger passed into the rectum—a method of examination which it is often useful to adopt in the diagnosis of hip-disease in childhood. The writer has met with four instances in which intra-pelvic abscesses have burst into the rectum, and fæcal material has passed from the bowel through the hip-joint, so as to reach the surface through sinuses opening behind the trochanter. All these were fatal—one after amputation at the hip-joint had been performed.

Amyloid Degeneration.—Should suppuration be copious and of long standing, amyloid degeneration of the internal organs, indicated by enlargement of the liver or spleen and the presence of albumen in the urine, may take place. The period at which this condition is developed varies, however, very much in different instances. In some it is present soon after suppuration has commenced, while in others it makes its appearance only when the discharge of matter has been going on for many months, or even for two or three years.

Tubercular Meningitis. — Formerly, when hip-disease was so frequently allowed to advance to the chronic suppurative stage, tubercular meningitis was by no means a rare complication; but at the present day, when suppuration is so largely diminished by treatment in which rest is combined with the early antiseptic opening of abscesses, it is much less often seen. It may, however, be developed at any period of the disease: in some instances it has occurred when no suppuration had taken place; in others after the joint-affection had long been cured. It always terminates fatally.

It is remarkable that pulmonary phthisis is rarely met with in patients suffering from hip-disease.

Treatment.—In its early stage hip-disease must be treated by absolute rest, combined with the means by which any abnormal posture of the limb may be gradually corrected. The best method for carrying out these indications is that of extension by the weight and pulley. The patient is placed on a firm mattress, with a board beneath it to keep its surface flat. The pillow should be wedge-shaped, so as to support the head in a raised position at a convenient angle; but it should be large enough only to correspond to the head. If it is of the ordinary size the patient raises his shoulders upon it, so that his trunk is no longer in a horizontal position. The weight is connected with the limb by means of the ordinary 'stirrup.' This consists of a piece of stout strapping, from two to four inches wide, which is doubled upon itself at its middle so as to form a long loop, the sides of which are placed one on the inner and the other on the outer aspect of the limb, from the foot to the middle of the thigh, a loop of about four inches in length being formed below the sole. The strapping is kept in place by circular strips, over which a bandage is applied. A thin piece of wood of the shape of a visiting card is placed transversely in the lower end of the stirrup, to prevent the side pieces from pressing on, and excoriating the malleoli. Through the centre of this piece of wood, and through the strapping at a corresponding point, a strong piece of cord is passed, and carried down to the foot of the bed, where it passes over the pulley and supports the weight. The amount of the weight must vary with the case, but in children under twelve years of age from three to five pounds should be used; in young adults as much as six to ten, or even more, may occasionally be required. It is, however, not to its large amount, but to its continuous action, that the weight owes its efficacy in these cases. Very heavy weights put a mischievous strain upon the ligaments of the knee, and often produce œdema of the foot. A cradle should be used to keep the weight of the bed-clothes off the feet.

In the case of a child, the mattress should be protected with a piece of macintosh, covered with a draw-sheet. It is absolutely necessary that, for a time, the patient should be confined to the horizontal posture. To ensure this a long splint should be placed on the opposite, or sound side, and a chest-band will also be useful. This consists of a piece of webbing, an inch or two wide, passing across the upper part of the chest between the two armpits, and ending in two loops through which the arms are passed, and through which, also, another piece of webbing is threaded, which runs transversely across the surface of the bed under the patient's shoulders, and is securely tied at its two ends to the sides of the bedstead. When this contrivance—which ought not, however, to be tightly applied—is worn, the patient can neither sit up nor turn on his side.

In adjusting the limb, the first step is to exchange the compensatory position which it has assumed for its real position. Thus, if there is lordosis, this must be removed by flexing the limb to the necessary extent on the trunk. If the pelvis is oblique, so that the anterior iliac spine on the affected side is lower than that on the sound side, the limb must be moved outwards till the two spines are again at the same level. If, on the contrary, the iliac spine of the diseased side is higher than that on the sound side, the limb must be adducted till the spines are again horizontal. Secondly, in whatever position the limb has now been brought, it must be maintained by pillows, or by some equivalent support, and the pulley must be adjusted in a line with the long axis of the thigh, so that extension is made exactly in this line. In instances in which deformity is extreme, the adjustment of the limb is a matter requiring some ingenuity, and a light wooden framework, covered with pillows, may be necessary to support it. But for ordinary cases sloping or wedge-shaped pillows will be sufficient. The reason for arranging the limb in the manner now described, and making traction in the long axis of the thigh, is that when this is done the weight has a direct tendency to remove intra-articular pressure, while if extension is not thus made in the axis of the deformity, the femur is converted into a lever, whose fulcrum is at the acetabulum, so that the articular surfaces are pressed still more firmly together. As the contraction yields, it is necessary to alter the position of the pulley and the height of the pillows, so that extension shall still correspond with the axis of the thigh. It is often surprising to see how quickly weight-extension thus applied will remove deformity. In recent cases the limb may be restored to its natural position in ten days or a fortnight; while, even in cases of long standing, its position may be corrected in from three or four weeks to two months.

It must be noticed that, although it removes flexion, the action of the weight has little effect on either adduction or abduction, so that when the limb has been restored to a position of extension on the trunk, abduction, showing itself as apparent lengthening, or adduction, taking the form of apparent shortening, will still remain.

Abduction calls for no interference, for it will gradually disappear spontaneously if movement in the joint is preserved; while, should ankylosis result, the presence of abduction, assuming the form of apparent lengthening, will be a distinct gain, for it will tend to compensate for any real shortening that may have taken place. Instances are not rare in which a limb, which has become permanently fixed in a position of abduction, has the appearance of being of the same length as its fellow, though it is in reality shortened to the extent perhaps of an inch or an inch and a half. Adduction is of greater moment, for it has the effect of making the limb practically shorter than its fellow. It is therefore necessary if possible to correct it. This may be done in the following manner. A weight somewhat heavier than that which would ordinarily be used—for a child of five or six years six pounds may, for the present purpose, be employed—is attached to the affected limb in the ordinary way. A long splint is then applied to the sound side, unless this has already been done, and at its lower end is fastened a cord which runs along its outer side upwards to the head of the bed, where it is made to turn over a pulley and sustain a weight of five or six pounds. By this means, while the affected limb is drawn down, the opposite limb is carried in a contrary direction. There are few cases in which, unless firm ankylosis has taken place, this method will not in the course of two or three months completely remove apparent shortening dependent on adduction. Should the limb, in consequence of the absorption of the head of the femur, tend to be everted, this posture may be corrected by the following plan:—An outside splint, long enough to extend from the level of the sole to the knee, and furnished with a cross-piece so that it is T-shaped at its lower end, is applied to the outer side of the limb, and is at first tilted with sand-bags (one of which is placed upon the outer, and the other beneath the inner end of the cross-piece), so that it is rotated outwards to the same extent as the foot and leg. It is then gradually rotated inwards by changing the slant of the cross-piece and altering the sand-bags until, carrying the limb with it, it has brought the latter into its natural position.

Formerly it was the custom, in cases of considerable deformity, to place the patient under the influence of chloroform, and to forcibly straighten the limb. This was a violent proceeding, which often inflicted much injury. It is now very generally, and very properly, discarded. In those instances, however, in which the limb is so firmly held by adhesions that no improvement is obtained by weight-extension, the following plan may be adopted. While the patient is under an anæsthetic, the limb may be straightened by manipulation through two or three degrees, and may then be left again to the action of the weight. It will be very generally found that, after extension has once been thus commenced, the weight will do the rest, and the limb will gradually come down into its normal posture. This proceeding must always be very carefully carried out, and only very slight force ought to be employed.

Mr. Thomas, of Liverpool, has introduced an excellent splint for hip-disease, which has become very popular in England. Made entirely of iron, it consists essentially of a well-padded bar, running along the posterior aspect of the limb from the inferior angle of the scapula to just above the ankle. This bar is easily bent with wrenches to the outline of the trunk and limb, but it is strong enough to maintain its shape when once applied to the patient. At its upper end is a chest-piece, made of iron behind, and ending in a strap and buckle in front, for fastening round the thorax. The splint is kept in place at its lower end by a semi-circlet made of sheet iron behind, and fastening with a strap and buckle round the leg in front. A similar fastening is added at the middle of the thigh. In the lumbar region of the spine the splint is fixed by a wide flannel bandage, surrounding it and the trunk. In acute cases this splint is applied to fix the limb as the patient lies in bed; and if deformity is present, it is fitted to the shape of the limb, and is gradually straightened, so that the position of the limb is corrected. In the later stages of treatment the patient is allowed to be upon crutches and to wear a high boot on the opposite foot, so that the affected limb does not touch the ground.

This splint is very useful, both for the purpose of maintaining the limb, when disease is acute, completely at rest (and for this purpose it may advantageously be combined with weight-extension), and in the convalescent stage, in order to prevent the return of flexion. Children who are wearing this splint can also be lifted without disturbance of the limb. The principal objection to it is that if long-continued it leads to considerable atrophy of the muscles of the thigh. Moreover, as it effects no extension, it does not prevent, when bone-absorption is taking place, the sliding of the upper end of the femur towards the dorsum ilii—in other words, the gradual shortening of the limb. Nor does it exert any direct influence to remove adduction. Thomas's splint, in short, is chiefly useful for the purposes of fixing a limb in acute disease, and for preventing the return of flexion when the patient is up and using crutches. Its simplicity and durability, and the ease with which it can be managed, are strong recommendations of this appliance. While it is in use the patient must be placed on a soft bed, instead of on the firm mattress necessary for weight-extension. A common fault in this splint, as supplied by the instrument-makers, is that it is much too sharply bent where it corresponds with the junction of the nates with the thigh, with the result that it may lead to pressure on the great sciatic nerve to a degree which seriously interferes with the nutrition of the limb. This curvature ought to be modified before the splint is applied.

Mr. Bryant has invented an appliance consisting of two outside long splints, one for each limb, extending from the sole to the axilla, and fastened together at their lower ends by a cross-piece, and at their upper end by an iron rod arched over the chest, so that they are maintained in a parallel position. The object of this double splint is to keep the patient at complete rest, and to prevent abduction or adduction. The various forms of shield splints made of leather or gutta-percha, and the more recently introduced plaster of Paris splint, are all rendered very nearly useless by the fact that as they have very little power to prevent flexion they entirely fail to keep the joint at rest. They are in every respect inferior to Thomas's splint, which ought to be regarded as having completely superseded them.

In America, Taylor's and Sayre's splints, or some of their numerous modifications, are much in use. These appliances, which are described in all American works on surgery, are intended to maintain extension while the patient is allowed to move about in the open air. The defect, however, in all of them is, that it is impossible, except by constant readjustment, to maintain extension, or even to secure adequate rest of the limb. Hence this form of apparatus has never become popular with English surgeons.

It is difficult to say how long treatment in any particular case should be continued. It must be remembered, however, that recovery takes place very slowly, and that relapses are very prone to occur, so that the danger is that time enough will not be allowed. Very few cases, even among those that are treated efficiently from their very commencement, are cured by less than six months of absolute rest, and even eighteen months or two years may be necessary. When weight-extension is the method employed, it should be maintained for at least three months after all pain and tenderness have completely disappeared. Then the weight should be very gradually reduced, and the patient should not be allowed to be up for a month after all extension has ceased. He may then get about with crutches, with a high boot on the sound side, and with a Thomas's splint applied to the affected limb ; and this form of treatment must be persisted in for at least another six months, or even a year, at the end of which period Thomas's splint may be left off during the day, although it should still be worn for some months longer during the night, in order to guard against any recontraction of the limb.

It is very important that the formation of matter in hip-disease should not be overlooked, yet large collections sometimes escape notice. If an abscess is detected, it is best to evacuate the collection at once by some means by which septic changes may be prevented. The writer has largely employed Lister's method. A free incision is made, and matter is gently pressed out, so that the abscess-cavity is emptied. A drainage-tube just long enough to enter the abscess is introduced, and the ordinary carbolic dressings are applied. The results have been extremely satisfactory. There is, in the great majority of cases, no rise of temperature, nor any constitutional disturbance. Where suppuration is acute, and connected with inflamed bone, discharge necessarily continues for a time, but the matter quietly escapes through the small sinus which is soon all that is left of the incision, so that no injury is caused to the soft structures of the limb. When the bone-disease, under the influence of rest, comes to an end, suppuration ceases, and the wound quickly heals. In instances in which pus has formed late in the case, and where active disease has come to an end, the abscess has frequently been soundly healed within a month or six weeks, while not a few have been completely closed within three weeks.

The safety with which matter can be evacuated by Lister's method enables us entirely to change the old form of practice in the management of these abscesses, and the early withdrawal of matter may be confidently recommended. When this rule is followed, the wide burrowing of pus in the limb, and the formation of numerous sinuses —hitherto so common an occurrence—is avoided, except in the very few instances in which acute scrofulous bone-disease becomes very extensive, and is attended with wide infiltration of the limb by inflammatory products.

Excision.—Very different opinions are still held as to the value of excision as a means of treating hip-disease. In the view of the majority of surgeons the operation is one that should be employed only in otherwise hopeless cases; for experience, the force of which is daily increasing, shows that if the treatment by rest and the evacuation of matter is efficiently carried out before the disease has reached an advanced stage, recovery, with a much more useful limb than that which is left after excision, will usually take place. The result, however, of excision in cases in which the operation has been performed only after all other means have failed, and in which the general health has suffered considerably, is very unsatisfactory; suppuration often continues to be as free after as it was before the operation, the wound never heals, and the patient dies of exhaustion or visceral disease ; or if healing is at last effected, this is only after so long a delay that very little has been gained by the operation. In view of these failures, some authorities have advised that the operation should be performed at a much earlier date—as soon, in fact, as suppuration is detected. If this is done, it is maintained that the wound quickly heals ; the local nidus of tubercular disease is removed, so that the danger of systemic infection is averted; and the patient escapes the suffering and dangers which are incidental to the later stages of the affection. The argument, however, which is widely accepted as conclusive against early excision, is the same as that which applies to the case of the removal of a strumous testis in the early stage—namely, that if proper treatment is adopted repair will take place, and the organ may be saved. Other objections to early excision are that the operation is one that cannot be spoken of as free from considerable risk ; and that the limb, after even successful excision, is generally much shorter, and much less strong and useful than that which is left when a cure has been obtained without operative interference. Nor is there much force in the proposition that the operation diminishes the risk of systemic infection, for it is impossible to be certain that all infective material (the presence of which, however, is, in the earlier period of the disease, a mere matter of assumption) will be removed, or that other centres of infection do not already exist. Moreover, systemic infection is, after all, so rare, that the possibility of its occurrence is no justification for the sacrifice of such an important joint as the hip.

Although, however, excision generally fails when employed in the later stages of the disease, and although an early resort to it is not warrantable, there are certain conditions in which the operation ought to be performed. These are—(*a*) when the whole or a considerable portion of the head of the femur has become detached, and is lying, as a sequestrum, in the acetabulum or in the cavity of an abscess. This occurrence, which is not very rare, may be suspected when suppuration continues to be copious, and when it is found that the upper end of the femur is abnormally movable, so that it can be pushed upward on the dorsum ilii, and then be drawn down again, especially if grating between the bony surfaces is felt. In these cases—in which, however, what is done is rather an operation for the removal of dead bone than a systematic excision—recovery generally quickly takes place, and a very satisfactory result is obtained. (*b*) When suppuration continues to be copious after three or four months, and the patient is losing flesh and strength in spite of rest and the provision for the free drainage of matter, and when careful examination discloses no evidence of extensive disease in either the femur or the pelvis. If the femur is extensively diseased, it is usually found that sinuses lead to bare bone in the upper end of the shaft; the bone is felt to be enlarged when grasped between the fingers in a direction from before backwards, and there is general brawny thickening of the soft parts, accompanied by burrowing of matter for some distance in the thigh. The formation of sinuses about the ilium, and the fact that a probe, introduced into any openings that may have formed, runs towards the pelvis, will point to the existence of disease of the acetabulum. Important information may also be obtained by exploring the pelvic aspect of the acetabulum with the finger passed into the rectum, when swelling, indicating the presence of an abscess, may sometimes be felt. When the femur is extensively diseased (chronic myelitis sometimes affects the upper third or even more of its shaft) amputation is the only operative proceeding that will suffice. When the pelvis is widely involved, excision will generally be useless, though in some cases it does good by securing free drainage. (*c*) Excision may also be advisable when long-continued and very free suppuration is associated with displacement of the upper end of the femur, attended with deformity which cannot be removed without operative interference. Should albumen appear in the urine, or enlargement of the liver be detected (evidences that amyloid degeneration of the viscera has commenced), the question of excision ought to be carefully discussed, for, if the operation can check suppuration, complete recovery of the internal organs may, and indeed very probably will, take place. It must, however, be remembered that amyloid disease often passes off as the disease subsides under rest and drainage of the joint, so that the mere presence of albumen or of an enlarged liver or spleen does not call for active interference, unless the discharge is very profuse and shows no tendency to decrease. The operation should, therefore, be performed only when it is evident that no improvement is to be expected from further delay.

It is sometimes better not to perform a complete excision, but to operate with the purpose of removing any sequestra that may be present, and of laying open any deep sinuses through which pus may have a difficulty in escaping. Great improvement, or even sound healing, may follow this method of treatment.

The Operation of Excision.—In cases suitable for the proceeding, the operation of excision is limited to the removal of the head and neck of the femur or what remains of these parts. The trochanter should not be taken away, and the soft structures around the bone, including the attachments of the muscles, should be as little disturbed as possible. The method formerly adopted, by which the upper end of the femur was stripped and forced out of the wound, has been superseded by the following proceeding:—A deep incision, four or five inches in length, is made from the base of the trochanter upwards in the direction of the fibres of the glutei; the edges of the wound are retracted, and the capsule, if it remains, is divided, so that the joint is opened from behind. The finger is then introduced to ascertain the condition of the bones and the position of the neck of the femur. A narrow saw is now passed along the finger, the neck is cut through, and the detached portion of bone is removed with sequestrum-forceps with as little violence to the neighbouring parts as possible. If the trochanter or the upper end of the shaft is extensively diseased, they must be removed; but it must be borne in mind that this step seriously interferes with the future usefulness of the limb, and should not be resorted to unless on the ground of clear necessity. The acetabulum must now be explored, and search made for sequestra. If any pieces of bone are found detached, they should be removed; but should the bone be found merely inflamed and bare, it should be left for subsequent healing by granulation. If perforation of the acetabulum has occurred, and abscess has formed in the pelvis, sufficient bone must be removed, with a gouge, to provide for the free escape of pus, and a drainage-tube should be introduced. The wound may be conveniently dressed with carbolic gauze. After the operation, the limb should be placed on a long splint, interrupted at the hip, or it may be supported between sand-bags, a light weight being suspended from the foot to prevent retraction.

Amputation.—Many circumstances have conspired, during the last few years, to induce surgeons to recommend a more frequent resort than formerly to amputation, as a means of treating certain cases of hip-disease. The introduction of the various forms of elastic tourniquet, and of Davy's lever, having provided the means whereby hæmorrhage can be, to a great extent, prevented, the operation has been found much less fatal than was anticipated. It is now known that amyloid degeneration is no bar to operative interference, and that patients often completely recover from this condition when the copious suppuration which has produced it is arrested; while the fact has become more and more clear that, in many cases of advanced disease, it is useless to hope for recovery by the expectant treatment, and futile to resort to excision. It is needless to say that amputation at the hip-joint ought only to be performed when there is good reason to believe that the patient has no other prospect of recovery. The cases in which the proceeding should be adopted are:—(*a*) Those in which there is extensive disease of the femur attended with copious and long-continued suppuration, persisting in spite of rest and free drainage; and in which the patient is steadily losing flesh and strength, and especially when albuminuria or enlargement of the liver is present, to show that amyloid degeneration of the internal organs is in progress. (*b*) When excision has been performed but has failed to arrest suppuration, and the patient's strength is becoming exhausted. An additional ground for resorting to amputation in these cases is that the operation is much more easily and quickly carried out when excision has been already practised. (*c*) When, in spite of careful treatment by rest and drainage, the disease continues to advance, and the patient's strength is not sufficient to enable him to effect repair after excision. (*d*) The operation may, sometimes, be performed in cases of free suppuration connected with extensive disease of the pelvis. The result of these cases must generally be doubtful; but recovery, otherwise hopeless, may perhaps be secured by the provision of such free drainage as is provided by the removal of the limb. Possibly, also, when the limb is removed, diseased bone, not previously within reach, may be got at and extracted.

As the patient is already in a condition of great prostration, care must be taken both to prevent hæmorrhage and to complete the operation with as little delay as is compatible with its careful performance. The bleeding which is most difficult to prevent is that which is derived from the vessels of the posterior flap. This may be guarded against by—1, Davy's lever, or 2, pads may be placed on the external iliac artery, just above the groin and over the posterior vessels as they leave the great sciatic notch; and an elastic tourniquet, made of tubular india-rubber, may be applied firmly, in a circular manner, over these pads.

The method of performing the amputation is a matter of importance. The old plan of transfixion may be rapidly carried out; but it has the disadvantage that the stump is so short that the patient will have little or no power to use an artificial limb in walking. When, however, the muscles are saved, so that a long stump is provided, the patient will be able to use an apparatus with which he can walk in a satisfactory manner; many surgeons, therefore, remove the limb by Furneaux Jordan's method. *See* Hip-joint, Amputations at the. The choice between this method of amputation and that by transfixion must be carefully made, and must depend upon circumstances. If the patient is fairly strong, so that it is thought he can bear a somewhat prolonged operation, it will be right to endeavour to secure for him the advantage of a stump which will enable him to wear an artificial limb; and Furneaux Jordan's operation should be selected. In cases, however, in which great exhaustion is present, the main question is, not what form of stump will be most useful, but how the patient's life can be saved; and in these instances the much more expeditious method of transfixion—when bleeding has been provided against by the use of Davy's lever or a carefully adjusted tourniquet—had better be selected.

Howard Marsh.

HIP-JOINT, Amputations at the.—Amputation at the hip-joint is an operation which, under any circumstances, and no matter what precautions may be adopted to avoid the traumatic accidents liable to occur from the necessarily great size of the wound, must be regarded as one of the most serious in the whole range of practical surgery. The rate of mortality that has hitherto attended it is exceptionally high. Dr. J. Bryant states that in military practice the 'immediate' amputation is attended with a mortality of 93 per cent., in civil practice 60 per cent., and in both combined 80 per cent; in non-traumatic cases it is under 41 per cent., and in the two classes taken together it is a little over 64 per cent. The conditions necessitating the operation, the shock, and the dangers of hæmorrhage and septicæmia, all contribute to make the prognosis in such cases one of the utmost gravity. 'Death,' observes M. Verneuil, 'is sometimes immediate, on the operating table itself; sometimes rapid in the first five hours, sometimes within two hours; at other times it occurs after the first seven days or later. Early deaths are by much the most frequent, ordinarily caused by the hæmorrhage which precedes, accompanies, or follows the operation, and which proceeds not only from the femoral artery, but also from the branches of the gluteal and the sciatic arteries. Later deaths are most frequently the result of blood-poisoning.' The four main factors, therefore, which have hitherto played so important a part in raising the mortality of this operation are:—

1. The serious conditions which necessitate the operation.
2. Shock.
3. Blood-poisoning.
4. Hæmorrhage.

Over the first of these the surgeon has obviously no control; with the second he is almost equally powerless, although there is the authority of Von Langenbeck for maintaining that hæmorrhage intensifies it, but with septicæmia and hæmorrhage he is in most instances able to grapple, and with good prospect of success. As regards the third factor, the absence of surgical fever in the cases the writer has operated upon, in all of which rigid Listerian antiseptic precautions were adopted previously, during, and subsequent to the operation, is evidence of the powerful means that are now at our disposal for striking at those septic influences which have hitherto proved so fatal.

The arrest of hæmorrhage during amputation at the hip-joint can best be effected by one of three methods—(1) the abdominal clamp of Sir J. Lister; (2) Davy's rectal lever; and (3) elastic pressure. In the first of these the defects are threefold—(1) the difficulty of adjustment, especially in cases in which there is any deviation from the normal course of the aorta; (2) the danger to the intestines resulting from overpressure of the instrument; and (3) the interference with the respiratory movements from pressure on the abdominal muscles. The first two of these defects are acknowledged by Sir J. Lister, while the rectal lever introduced by Mr. Davy effectually gets rid of the third, but has itself special dangers, viz. unreliability in checking hæmorrhage where an unusual course of the aorta or common iliac artery exists; besides the necessarily fatal accident of perforation of the bowel resulting from an undue amount of force used in the introduction of the lever. The writer has tested the method in three cases of amputation at the hip-joint. In the first two the lever acted perfectly, the operations being practically bloodless; in the third it was not so satisfactory, the hæmorrhage being such as to give rise to anxiety. Elastic pressure as suggested by Esmarch appears to be the most effectual method, and the one attended with the minimum of danger. A simple mode of making such pressure has been recommended by Mr. Jordan Lloyd. Having first produced anæmia of the limb by an Esmarch bandage, he takes a strip, about two yards in length, of a Martin rubber bandage, and passes it doubled round the thigh at the groin. An ordinary roller bandage is then placed on the external iliac artery, and 'the ends of the rubber are firmly and steadily drawn by an assistant upwards and outwards, one in front and the other behind, to a point above the centre of the iliac crest of the same side.' The portion of the bandage crossing the groin obliquely presses on the roller, which in its turn presses on and occludes the external iliac artery, and the other portion, passing behind, closes the gluteal vessels, bleeding from which gives as a rule in this operation most trouble and anxiety.

The following are the methods by which amputation at the hip-joint may be performed:—

I. Single flap (anterior or internal).
II. Double flap (antero-posterior or lateral).
III. Oval.
IV. Circular.
V. Modified circular.

The first of these procedures may be thus described:—

The parts about to be operated on having been rendered aseptic, anæsthesia induced, and some of the measures already mentioned taken to prevent hæmorrhage, the patient should be so placed on the table that the pelvis should project beyond its edge. The scrotum should be drawn aside by an assistant with a broad bandage or cloth; another assistant should stand beside the operator to take charge of the anterior flap and, if necessary, make pressure on the femoral artery; a third should support the condemned limb and thoroughly understand when to flex, extend, abduct, and adduct the limb during the performance of the operation. The thigh being slightly flexed on the pelvis the operator takes a long narrow-bladed catlin (Liston's), the cutting portion of which should be at least twelve inches in length, and should enter it at a point midway between the anterior superior spine of the ilium and the great trochanter, and carry it inwards and backwards to a point an inch below and in front of the tuber ischii. This step of the operation, if done skilfully, should open the capsule of the joint. The operator then with a rapid sawing movement carries the knife longitudinally downwards and forwards, during which manœuvre the assistant passes his fingers behind the flap, as soon as room is afforded him, in order to make, if necessary, pressure on the femoral artery. The termination of the flap should correspond to the junction of the upper and middle thirds of the thigh. The anterior flap having been formed, reflected, and compressed by an assistant, the limb should be extended and abducted, and the capsule, thus made tense, freely opened. The head of the bone will now protrude, and the round ligament and posterior portion of the capsule should then be divided. The limb should then be rotated inwards, and the attachments to the great trochanter divided. The knife is then placed behind the bone, and the posterior tissues divided obliquely downwards and forwards.

In performing the *antero-posterior* or double-flap operation, the long anterior flap having been formed in the manner described, the knife is carried round and under the thigh and a lunated incision involving the integument and fascia made, connecting the two extremities of the anterior flap. The deeper tissues are then obliquely divided, following the edge of the retracted skin, and a short posterior flap thus made, one-third in length of the anterior flap. This method the writer has always adopted.

In the *oval method*, recommended by Verneuil, the operator makes a vertical incision about two inches in length, involving only skin and fascia, commencing an inch below Poupart's ligament. This incision is then carried downwards, outwards, and backwards, then transversely along the gluteal fold, and finally obliquely upwards and inwards to the termination of the vertical incision. The femoral vessels having been exposed, and the artery ligatured above and below the origin of the profunda, the latter vessel in its turn is also secured. Ligature of the femoral vein is likewise recommended. The deeper incisions through the muscles following the line of the integumentary incision are then made, every divided vessel being ligatured. The capsule is then opened and the trochanteric muscular attachments divided, the thigh having been depressed, and the head of the bone protruded. On the removal of the limb a large gaping wound will result, which cannot be closed. This M. Verneuil considers an advantage, as no accumulation of fluids liable to undergo putrefactive changes occurs. The wound is dressed on the 'open' principle with pledgets of lint or charpie soaked in some antiseptic solution. The writer does not recognise the alleged merit of this procedure.

The *circular method* of amputation is performed by making an incision, involving primarily only skin and fascia, at a distance of from six to eight inches below the anterior superior spine of the ilium. The skin is then retracted, and the superficial and deep layers of muscles successively divided. The bone is then reached, the capsule freely divided close to the cotyloid cavity, the muscular trochanteric attachments divided, and the head of the bone made to protrude by depressing and abducting the thigh. This method is preferable to that which immediately precedes it.

Mr. Furneaux Jordan (*Lancet*, March 22, 1879) has proposed a mode of amputating at the hip-joint for which he claims many advantages. The principle of the operation is a primary enucleation of the bone and a subsequent division of the soft structures of the thigh at any desired spot, 'the middle of the thigh, or below, or even near the knee.' A straight incision is first made, the trochanters and upper part of the shaft are freed from their muscular attachments and the capsule opened. The shaft is then cleared downwards from all its attachments for a considerable distance and lastly 'a few free sawing movements with a long-bladed knife through the thigh from which the bone had been removed' complete the operation. The advantages claimed for this operation over that usually performed are—the wound being less severe, the cut surfaces less extensive, less shock, less hæmorrhage, and less opportunity for septic infection. The absence of the bone enables the operator to cut the muscles on, or nearly on, a level with the skin, their retraction under these circumstances being so great that the skin readily covers them.

The operation would clearly not be indicated in cases where the soft tissues were much engaged or in cases of malignant disease, and it leaves necessarily a large pendulous, boneless mass. These defects may, not altogether without reason, be advanced as arguments against the operation. William Stokes.

HIP-JOINT, Dislocations of the.—These injuries are rare, and few surgeons can claim a very large experience of the various displacements, whilst the opportunities for making recent dissections are very limited. Consequently, much that has been written concerning the pathology of dislocations at the hip has been founded on experiments made upon the dead subject. This method of inquiry, though useful, is scarcely reliable; and the results require to be checked by more careful dissections of recent cases. Fabbri, who made a series of elaborate experiments, and laid down rules for the artificial production of the various dislocations, has been followed on the same lines by Tillaux and H. Morris. The general result of these observations is to the effect that, the lower part of the capsule being the weakest, and the lower edge of the acetabulum the least elevated, in all dislocations of the hip the head of the bone escapes primarily through this region, and arrives secondarily at its characteristic position. Further, according to Morris, abduction is the position in which all dislocations of the thigh happen. This scarcely accords with clinical experience. Thus, a case of dislocation on to the dorsum ilii, which came under the writer's notice, was caused by the squeezing and rolling of a man's thighs and hips between a moving omnibus and a wall, in which position abduction could scarcely have occurred; and Hamilton mentions a case caused by a fall from a height on to the outer side of the knee, where a contusion existed to verify the patient's statement. Tillaux, indeed, avers that adduction, with flexion and internal rotation, will send the head of the bone out below the tendon of the obturator internus, and his belief is that all dorsal dislocations are primarily incomplete ischiatic. In curious contrast to these views are those of R. A. Vance, who asserts that if the acetabulum be divided into 360 degrees, it can be truly said that dislocations occur at every degree. Eve, also, has collected several cases of direct dorsal dislocation; and there is a specimen in St. Thomas's Hospital, in which the head of the femur is seen to have perforated the capsule above the obturator internus tendon.

Since the days of Astley Cooper, who, perhaps more than any other observer, made clear the signs by which the various displacements might be recognised, all surgeons have admitted four distinct forms of dislocation at the hip-joint. These are generally spoken of as—(1) dislocation upwards, or upwards and backwards, on to the dorsum ilii; (2) dislocation backwards, or upwards and backwards, into the ischiatic notch; (3) dislocation downwards, or downwards and forwards, into the foramen ovale; (4) dislocation forwards, or forwards and upwards, upon the pubes.

It is time perhaps that some less cumbersome and lengthy nomenclature was adopted for these injuries, similar to what has now been generally accepted for dislocations at the shoulder-joint; and the writer suggests the terms *superiliac*, *supersciatic*, *superthyroid*, and *superpubic*, to indicate respectively these several displacements. If philologists take exception to these terms, their convenience must be their apology, and they are not more barbarous than those in use for the homologous joint of the upper extremity. These four are usually regarded as the *regular* dislocations of the hip-joint; but others are met with in which the head of the femur occupies various intervening points on the circumference of the acetabulum, and the latter are regarded as *irregular* or *anomalous*. Bigelow has laid great stress on the importance of the ilio-femoral or inverted Y-shaped ligament in determining the character of the dislocation, and he would regard all cases as *regular* except those in which this ligament is 'wholly ruptured.' He also follows Malgaigne in regarding the position of the tendon of the obturator internus as the distinctive feature separating the superiliac from the supersciatic dislocation. In the former, according to these authors, the head of the femur escapes above the obturator internus tendon; whilst in the latter, which Bigelow terms 'dorsal below the tendon,' it escapes below the obturator, and then turns up behind it.

As regards the relative frequency of the four regular dislocations, rather more than half are superiliac, and about a fourth supersciatic; the superthyroid come next in order, and the superpubic are the rarest. The hip is most liable to dislocation between the ages of fifteen and forty-five, and the injury is very much more frequent in males than in females. Several cases have been reported at the age of four years, and one even as early as six months; whilst at the other extreme of life they have been known to occur after the age of eighty.

The Superiliac Dislocation (dislocation upwards and backwards on to the dorsum ilii) may be caused by a fall on the outer side of the knee and thigh, by a wheel passing over the hip, or by a weight falling on the back when the patient is stooping. Malgaigne mentions two cases caused merely by a twist of the limb inwards and forwards.

The *symptoms* are shortening of the limb from one to three inches, adduction, inversion, and fixation. If the patient be examined when standing, the dislocated limb is seen to be semi-flexed and rotated inwards, so that the knee lies above and in front of the other knee, and the ball of the great toe rests on the instep of the other foot. The trochanter is above Nélaton's line, nearer the anterior superior spine of the ilium, and so rotated that its posterior angle projects. The buttock is flattened and the gluteal fold raised. In thin persons the head of the femur may be easily felt, and sometimes be seen, resting in its new position. By increasing the adduction it may be made to project, and during flexion it may be felt to descend. The natural motions of the joint are lost, and the movements are limited to slight flexion, adduction, and rotation inwards.

The ligamentum teres is ruptured, and the capsule often extensively torn, so that sometimes only the upper and anterior part remains unsevered. The untorn portion, nevertheless, has a powerful influence in retaining the bone in its new position; and the maintenance of the inversion is due, according to Bigelow, to the tension of the external fasciculus of the ilio-femoral ligament. Gunn, however, differs from Bigelow on this point, holding that the ilio-femoral ligament is relaxed in superiliac dislocation, and that the continuance of the position is due to the tension of the anterior inferior portion of the capsule and the fascia lata externally. The small external rotators are generally considerably damaged by the dislocation. In one case the head of the bone was found to have escaped between the pyriformis and gluteus medius; in another, between the obturator internus and pyriformis; whilst, in a case related by Cooper, the pyriformis, obturatores, gemelli, and quadratus were all completely torn across. The lower margins of the gluteus medius and minimus may be damaged, and sometimes the psoas and iliacus are partially torn.

If force sufficient to cause dislocation is applied to the limb when extended, the margin of the acetabulum is liable to be split off; but this is not a frequent accident. When it has occurred there has been a tendency to reluxation after reduction.

Reduction of the superiliac dislocation may be effected by *rotation* or *traction*. To reduce the bone by *rotation* the surgeon stands on the injured side, and placing one hand on the knee, grasps with his other hand the leg at the ankle. The limb is then flexed in the adducted position, by which means the ilio-femoral ligament is relaxed and the head of the bone is brought down towards the acetabulum; next, the limb is abducted, then rotated outwards, and finally carried down into the extended position. During this manœuvre the bone usually enters the socket with a sudden snap; but should flexion or abduction be carried too far, the head of the femur may glide round the acetabulum and become lodged in one of the other characteristic situations. Rupture of the outer branch of the Y-ligament, by lengthening the arc, may be another cause of the rotation method failing. An old formula in use at Guy's for many years, was, 'lift up, bend out, and roll out,' which is equivalent to flexion, abduction, and circumduction outwards. Hamilton, in advocating gentleness during reduction by rotation, says 'the limb should follow constantly its own inclination.'

Traction may be made in the extended position by placing the foot on the perineum for counter-extension, and pulling on the dislocated limb, as practised by Morgan and Cock. Traction can also be made, when the thigh is flexed at a right angle to the body, by raising the limb vertically, the surgeon's foot being placed over the anterior superior spine or on the pubes, to make counter-extension. Traction by means of pulleys, as practised by Astley Cooper, is now seldom employed, but, if required, may be applied as follows:—A jack-towel is passed between the thighs and secured to a staple in the floor near the head of the bed, to fix the pelvis and make counter-extension. A leather girth is buckled round the lower part of the thigh, and connected by the cords of the pulleys to a staple in the wall. Extension is then made, by tightening the pulleys, in a direction downwards and across the other thigh.

The Supersciatic Dislocation (dislocation upwards and backwards into the ischiatic notch, or dorsal below the tendon) resembles in many respects the superiliac. On this account some surgeons have grouped these two forms together as dorsal. According to Malgaigne, and, more recently, Bigelow, the distinction between them rests on the anatomical fact that, in the supersciatic, the head of the femur escapes below the tendon of the obturator internus, and then ascends behind it, so as to lie on this muscle or the pyriformis, the obturator tendon serving to hold down the neck and prevent the bone rising to the position of the superiliac. If the patient is examined in the erect position, the limb will be found adducted and inverted as in the superiliac dislocation, but shortened only to the extent of half an inch, or an inch at most. Allis has shown, however, that if both thighs be brought to a right angle with the body, the knee of the affected side will appear much lower. In the erect posture the great toe rests on the ball of the great toe of the other foot, and the knee is in front of the other knee. The trochanter projects less than in the superiliac, and the head of the bone is less evident behind; but in thin subjects it may sometimes be felt a little above the ischial tuberosity. Squires and Hamilton have detected the head of the bone in the sciatic notch by the finger passed into the rectum or vagina. Syme laid great stress on the lordosis which occurs when the limb is straightened; but this is merely the result of the joint being fixed in a state of semiflexion, and occurs whether the joint is fixed by contraction of the psoas and iliacus, by hip-joint disease, or by dislocation. Passive movement is limited to slight flexion and adduction. Flexion is believed to be essential for the production of this dislocation, and, if seen immediately after the accident, the limb may be found in this position strongly adducted across the other; but the weight of the limb in the erect posture causes the head of the bone to rise behind the obturator to the position of the great sciatic notch. Bigelow, contrary to most observers, maintains that inversion is greater in this dislocation than in the superiliac. Reduction has been found difficult and even impossible in some cases. This Sir A. Cooper accounted for by supposing the head of the femur to have become impacted in the sciatic notch; Bigelow attributes the difficulty to the hooking of the head on the tendon of the obturator internus; whilst Tillaux holds that it is due to the untorn portion of the capsule. The head of the bone is not always found resting on the pyriformis and margin of the greater foramen; sometimes it has been found on the spine of the ischium, or even lower. Fabbri attempted to distinguish between these forms, terming the higher 'sacro-sciatic,' and the lower 'ischio-sciatic.' As the head of the bone escapes between the gemellus inferior and the quadratus femoris, the latter muscle is the one more constantly ruptured than any other. Next to it, the gemelli and obturator externus are apt to be lacerated. The capsule is usually torn from the femur at the lower and back part. If the obturator internus gives way, the dislocation may become consecutively superiliac.

Reduction of the supersciatic dislocation by rotation differs but little from that of the superiliac variety; but to disengage the head it may be well to commence by over-adducting and rotating a little inwards, then to flex, abduct, rotate outwards, and extend. Flexion should not be carried to the same extent as in the superiliac, or the head will be brought round into the thyroid foramen. Sometimes, when rotation has failed, by placing the hands under the knee and lifting up the thigh, whilst repeating the manœuvre, the head may be drawn into its socket. If traction is employed by means of pulleys, the direction of the force should be across the middle of the sound thigh, the patient being on his side.

The Superthyroid Dislocation (dislocation downwards, or downwards and forwards, into the foramen ovale) may be caused by a fall with the limb in an abducted position, or by a weight striking the pelvis when the back is bent and the thighs are separated. Abduction is essential for its production. The lower part of the capsule is torn through, the ligamentum teres ruptured, and the head lies on the obturator externus muscle over the thyroid foramen. The pectineus, adductor brevis, and obturator externus are the muscles which suffer most, whilst the psoas and iliacus are put forcibly on the stretch.

The chief *symptoms* are abduction and semiflexion, with apparent lengthening of the limb. When the patient stands on the sound limb, the foot on the dislocated side is carried in advance and usually pointed nearly directly forwards. The body is bent forwards and towards the affected side, either to relieve the tension of the psoas and iliacus, or, as Bigelow would explain, to reduce the flexion of the thigh consequent upon the trochanters being held up by the ilio-femoral ligament after the head has descended. The heel is raised, and the knee separated from the other knee. On the outer side the prominence of the trochanter is lost, and there exists a hollow, bounded anteriorly by the line of the tensor vaginæ femoris; whilst on the inner side the adductor muscles are rendered tense, and by deep pressure the head of the bone may sometimes be felt beneath them. Anteriorly, where normally the soft tissues are supported by the head and neck of the femur, a lack of resistance is felt with the hand; and, behind, the buttock will be noticed to be flattened and the gluteal fold lowered. Pain is felt along the course of the obturator nerve, and the movements of adduction and extension cannot be effected even with external force. Astley Cooper stated the lengthening of the limb to be two inches, but this is mainly due to the oblique direction of the pelvis. The limb being semiflexed and abducted, and the trochanter tending to drop into the acetabulum, measurement from the anterior superior spine of the ilium to the inner malleolus usually shows a distinct shortening. Thus Malgaigne found a shortening of two centimètres, Rivington half to three-quarters of an inch, and Morris an inch and a quarter.

To *reduce* a superthyroid dislocation by rotation, the limb is first flexed nearly to a right angle with the trunk, then adducted, rotated inwards, and brought into a state of extension. Over-flexion may convert it into a supersciatic or superiliac dislocation, in which case outward rotation may be necessary for its reduction. Traction may be sometimes effectually applied, in the flexed position, by the surgeon carrying the leg over his shoulder, grasping and raising the thigh, whilst the pelvis is held down and the head of the bone is drawn outwards by a band passed between the thighs. Another way, formerly much in vogue, was to place the patient astride a bedpost and draw the dislocated limb inwards. To employ traction by means of pulleys, it is necessary first to fix the pelvis by a broad band around both ilia; a girth is then passed round the inner side of the dislocated thigh and through the loop of the pelvic band. The pulleys are connected to the girth around the thigh, and whilst extension is being made in a direction upwards and outwards, the surgeon passes his hand under the sound leg, grasps the ankle of the dislocated extremity, and draws the limb inwards.

The Superpubic Dislocation (dislocation upwards and forwards on to the pubes) is caused by violence which forces the limb into a position of abduction and over-extension, such as may happen when a person stepping unexpectedly into a hole falls backwards. The ligamentum teres is ruptured, and the head of the femur, tearing through the capsule on its antero-internal aspect, ascends upon the body of the pubes beneath or internal to the psoas and iliacus. Usually the head lies external to the femoral vessels, but in one case related by Astley Cooper it lay upon the vessels, stopping pulsation in the artery; and in a case observed by Bransby Cooper, and in another by Gosselin, it lay internal to the vessels. The pectineus and adductor brevis muscles suffer most, and the small fleshy muscles behind the joint—the quadratus and gemelli—are usually torn, and the psoas and iliacus may be lacerated.

The *symptoms* are shortening to the extent of about an inch, abduction of the limb, and eversion of the foot generally to a right angle with the other. The trochanter lies in a hollow on the outer aspect of the hip, and is nearer the anterior superior spine of the ilium, the buttock is flattened, and the head of the femur is to be felt as a hard round ball resting upon the pubes. The movements are limited to slight flexion and abduction. Pain and numbness are felt along the course of the anterior crural nerve, and retention of urine more frequently follows this dislocation than any other, owing probably to an inhibitory action excited by irritation of the genito-crural nerve.

Reduction may be accompanied by rotation in a manner similar to that employed for the superthyroid dislocation, but flexion should be carried further. One hand seizing the ankle and the other resting on the knee, the limb is flexed in the abducted position till the knee nearly touches the abdomen; adduction, rotation inwards, and extension of the limb are the movements then successively employed. Reduction by manual extension has been successfully employed by Morgan and Cock with the foot on the perineum for counter-extension. In one of Morgan's cases, whilst assistants made extension on the limb and he made counter-extension with his foot on the perineum, the patient was told to sit up, the surgeon at the same time rotating the limb inwards, when reduction immediately followed. Thus, flexion and rotation inwards were associated with manual extension and perineal counter-extension. Larrey succeeded in one case by carrying the patient's knee over his shoulder, then clasping his hands over the dislocated bone, and pressing it down into its socket. In Astley Cooper's method by pulleys, extension was made from above the knee in a direction downwards, outwards, and backwards, and counter-extension by means of a band between the thigh and perineum; a towel was then passed round the upper part of the thigh, by which means the head was lifted over the edge of the acetabulum.

Irregular or Anomalous Dislocations.—A certain number of dislocations of the hip cannot be strictly classed under the four regular forms described, but it will be found convenient to arrange them for study according as their clinical signs bring them into near relation with the superpubic, superiliac, supersciatic, or superthyroid forms.

Irregular Dislocations allied to the Superpubic.—In some instances, when the general appearance of the dislocated limb resembles that present in the superpubic form, the head of the bone, instead of passing forwards and upwards so as to lie on the body of the pubes or near its junction with the ilium, is found to pass more directly upwards. These dislocations have been classed as *supracotyloid*, and there are several varieties. In some instances (adspinous) the head of the bone lies just internal to the anterior inferior spine of the ilium, as in cases reported by Morgan, Olknow, and Agnew. In others (abspinous) the head lies on the ilium just external to the anterior inferior spine. In several (supraspinous) the head has been found lodged above the inferior spine, between it and the superior, as in cases reported by Cummins, Lente, and Travers. Lastly, there are cases (infraspinous) where the head rests on the edge of the acetabulum between it and the anterior inferior spine, as in cases reported by Gerdy, Wormald, and Cruveilhier. In all these cases the limb was in a state of eversion similar to what is met with in superpubic dislocation, but carried, in some instances, to an extreme degree, so that the toes pointed outwards and backwards. There was, in addition, a variable amount of shortening and abduction or slight adduction. Reduction should be accomplished by the same manœuvres as recommended for superpubic dislocations.

Irregular Dislocations allied to Superiliac.—There is no irregular dislocation whose clinical signs would lead to its being classed near or among the superiliac; but experimenters on the dead have supplied us with new forms, which, so far as one can judge from clinical records, have never yet occurred among the living. The 'anterior oblique' of Bigelow is to be made from a dorsal by forcibly adducting and everting the flexed thigh across its fellow. Oldnow's case already referred to, which Bigelow places here, the writer, with the original case before him, cannot but regard as an irregular superpubic. The same will be said of the majority of the so-called 'everted dorsal' cases by those who can free themselves from theoretical considerations of the influence of ligaments and tendons. The marked eversion of the limb is the most important symptom in all these cases, and, what is perhaps even more to the point, in the cases successfully reduced by manipulation, rotation of the flexed thigh inwards was the manœuvre followed by success.

Irregular Dislocations allied to the Supersciatic.—These have been included under the general term *infracotyloid*, of which there appear to be several varieties, some being allied to the superthyroid. The head of the bone has most frequently been detected in a direction downwards and backwards from the acetabulum, lying between the spine of the ischium and the tuberosity. In this position one would expect the dislocation to be associated with much flexion of the thigh and inversion of the limb. This was the case with Wormald's patient, whose thigh was inverted, forming an angle of about 45° with the body, the shaft of the femur crossing the symphysis pubis and being immovably fixed. The head was found on dissection to rest opposite the upper part of the ischial tuberosity above the quadratus, and the obturator internus was torn through. In Kirkbridge's case the symptoms were almost exactly similar, and in both the head could be felt beneath the gluteus maximus. A case reported by Warren, and two dissected by Travers, in which there was inversion of the limb, the writer would include in this category. Reduction should be attempted by abduction and rotation outwards, followed by extension. Van Buren's case, in which there was shortening of an inch and slight eversion, whilst the head was 'obscurely felt in the back part of the sciatic notch,' must be regarded as an irregular supersciatic. It was reduced by extension in the flexed position.

Irregular Dislocations allied to the Superthyroid.—In this category the writer places all those infracotyloid dislocations in which there is abduction, eversion, and lengthening of the limb, whether the head of the bone be found to have taken a downward and forward, directly downward, or downward and backward direction. Those in which the head is found to have passed downwards, or downwards and slightly forwards, may be regarded as incomplete superthyroid, whilst those in which the head is found to have passed downwards and backwards are to be regarded as secondary, though by the term 'secondary' in this instance it may not be necessary to regard the original dislocation as having always been complete. Keate's case may be taken as typical of this latter class. A horse fell back on his rider in a deep narrow ditch, in which position they lay struggling for a quarter of an hour. The thigh was much flexed, much abducted, everted, and elongated, whilst the trochanter was depressed. The head was felt close to, and on a level with, the tuber ischii. A first attempt at reduction threw the head into the thyroid foramen, which the patient recognised as the position in which it was first dislocated; it was afterwards returned to the acetabulum. In Bouisson's case the symptoms were almost exactly the same, and the head was felt in a similar position. In others, with the same symptoms, the head could not be felt. In Roux's case, the limb was lengthened, slightly flexed, and abducted, and the head was felt during flexion above and a little internal to the tuber ischii. In Luke's case, where there was abduction and lengthening without eversion, dissection showed that the head had passed directly downwards.

Dislocation *into the perineum* is a rare form allied to the superthyroid. It has usually been caused by a weight falling on the back when the thigh was abducted. The thigh is fixed at a right angle to the body, and the head of the bone can be felt near the raphè of the perineum, where it lies about opposite the junction of the ramus of the ischium with that of the pubes, and is apt to cause retention of urine by pressure on the urethra. There is a deep hollow in the usual situation of the trochanter, and the toes are sometimes everted and sometimes inverted. Reduction is best effected by vertical traction, when the patient is on his back, at the same time that the head is pushed outwards. In this way the head is usually first carried into the thyroid foramen, whence it may be reduced to its proper cavity.

R. Clement Lucas.

HODGEN'S SPLINT.—The suspension splint, devised by Dr. J. S. Hodgen, of St. Louis, United States, for the treatment of fracture of the femur, consists of a wire framework of such a length as to extend from the hip to a point just beyond the foot. From this framework hang in loops broad strips of cotton-sacking. The injured limb is suspended in this form of cradle, the foot being fixed by a strip of strapping to the cross-bar at the end of the wire-splint. The apparatus, together with the limb, is suspended by means of cords and pulleys, either to a long upright board at the foot of the bed, or to a bar extending high above the patient from one end of the bed to the other. Extension of the limb may be regulated by varying the obliquity of the extending cords, whilst counter-extension is kept up by the weight of the patient's body. This suspending apparatus is far more comfortable than the long, outside splint, as it allows some freedom in the movements of the body. It requires much attention, however, and care has to be often taken to prevent eversion of the foot.

HODGKIN'S DISEASE. *See* Lymphadenoma.

HORDEOLUS. *See* Eyelids, Diseases of the.

HORNS (*Synon.* Cornua cutanea).—Cutaneous horns are far from common; they are usually solitary, but several cases have been recorded in which they were numerous. They may occur on any part of the body, but the face, scalp, and penis appear to be the regions in which they are most commonly met with. They grow slowly, and are unattended with pain unless there is some inflammation at the base, which is marked by the appearance of a red areola; this is sometimes followed by a shedding of the horn, which leaves a superficial ulcer. Under these circumstances the horn is gradually reproduced. Horns vary from half an inch to several inches in length, and are larger at the base than at the distal extremity; they are apt to become dry and twisted, so that they often bear a close resemblance to the horns of some of the lower animals. They grow from the deeper layers of the epidermis, and are made up almost entirely of altered epidermic cells, which have a laminated arrangement. After the horn has been removed, it is a necessary part of the treatment to destroy the base from which it grows by means of caustic.

Robert Liveing.

HOSPITAL GANGRENE is a highly contagious form of acute inflammatory gangrene, of which, in its true form, owing to the improved hygienic and sanitary conditions of our hospitals, we rarely or never get an instance in this country. It is a rapidly spreading disease, accompanied by great constitutional disturbance, which almost invariably proves fatal and is of a most contagious nature, so much so, indeed, that it is occasionally denominated 'Gangræna contagiosa.' There is, nevertheless, a modified form of the disease which occasionally occurs, and sometimes assumes an epidemic form, to which the term 'hospital gangrene' is applied, but which should more properly be termed 'phagedæna,' since it differs in many essential particulars from the true hospital gangrene. It is accompanied by much less constitutional disturbance, is not of so distinctly contagious a nature, and involves little danger to life. It may be regarded as an intermediate condition between ulceration on the one hand, and true hospital gangrene on the other.

The views which have been held as to the *cause* of hospital gangrene are various, but there seems to be no reason to doubt that it is due to some specific virus, introduced into the wound. The experiments of Koch seem to prove that the gangrene is due to the presence of minute micrococci, which, when brought into contact with a wound, induce rapid death and destruction of tissue, by a process of multiplication and excretion of a soluble substance, which has a deleterious action on the cells of the part. These minute organisms do not exist in the blood of the patient, since blood-inoculation from a patient suffering from hospital gangrene produces no effect. It would appear that the growth and multiplication of these minute organisms may be favoured by certain atmospheric conditions, which are set up by overcrowding, deficient ventilation, and a want of proper cleanliness, and in this manner an epidemic outbreak of the disease is brought about.

On account of the resemblance of wounds attacked by hospital gangrene to 'diphtheria of wounds,' many authors have regarded the two conditions as identical; but they appear to differ in many essential particulars. There are not in diphtheria the same swelling and pulpy degeneration of the edges of the wound as are found in hospital gangrene; the disease in the former case spreads by the formation of vesicles at the margin of the sore, which run together and form excoriations, which subsequently become covered with a fibrinous infiltration resembling an eschar. Nor is hospital gangrene known to be followed by paralysis, which is so frequent a sequel of diphtheria. *See* DIPHTHERIA OF WOUNDS.

The exciting cause of hospital gangrene is, no doubt, in very many instances, direct contagion. This has been abundantly proved, not only by the experiments of Koch on the lower animals, but by undoubted instances in which the disease has spread by direct contact from one patient to another, and also where the attendant has inoculated himself from an infected patient by accidentally pricking his finger or otherwise. It seems probable, also, that the flies, which usually abound where a number of sick are congregated together, may be a source of contagion, carrying the poison from one wound to another.

Symptoms.—When a wound is invaded by 'hospital gangrene,' it becomes covered with a thick, ashy-grey, or black pulp. At the same time the sore increases rapidly in extent, and has a tendency to assume a circular form. The edges are sharp-cut, and the tissues become swollen and reddened, and in their turn become converted into a black or grey pulpy material, and in this way the wound increases with enormous rapidity. The discharge is thin, dirty yellowish-green, or blood-stained. The limb becomes swollen and hard. The sloughing mass remains adherent to the parts beneath, though at the same time it shows a tendency to separate at the margins, so that it can be moved to and fro when an attempt is made to separate it. At other times the disease appears to assume more the character of an ulcerative process. There is a rapid liquefaction of the tissues, so that the wound soon presents an excavated appearance, and spreads rapidly. The skin around is swollen and red, and would seem to melt away. There is a discharge of a fetid, blood-stained, seropurulent fluid. Generally the disease, whichever form it assumes, is at first confined to superficial structures, the deep fascia appearing to offer considerable resistance to the spread of the disease to the deeper structures. But after a time this tissue may be perforated, and extensive ravages result; muscles may be implicated, bloodvessels exposed and finally perforated, joints opened, and bones denuded of their periosteum and necrosed.

The constitutional symptoms are usually very severe. The expression betokens great anxiety; the body is bedewed with a cold and clammy sweat; there is a small, quick, and rapidly failing pulse. Pain of a burning, stinging character in the part, and frontal headache, are complained of. The respirations become short and hurried, the heart's action becomes weaker and weaker, and the patient sinks in a few hours. *See* PHAGEDÆNA.

Treatment.—There can be no doubt that when this disease attacks a patient he should be immediately isolated from all his surroundings, with special attendants who should be forbidden to mix with the other patients; and be furnished with special appliances and dressings. Should the disease invade a hospital or ward, it should be evacuated at once.

Abundance of fresh air is essential, and this may perhaps be best accomplished—especially in military surgery—by placing the patients under canvas in the open air. The strictest cleanliness is to be rigorously enjoined, and every precaution taken to prevent the spread of the disease from one patient to another. No sponges should ever be employed, but every material with which the wounds are touched should be burned at once.

An endeavour should be made to prevent the extension of the sloughing by the free application of fuming nitric acid to the wound. It should be carefully cleansed with lint or wool, and the whole surface of the sore, and the edges for some distance around, be freely swabbed with the acid, which should be allowed to remain in contact with the tissues for some minutes, so as thoroughly to soak into them. Opium should be given, and the patient's strength supported by the administration of liberal supplies of stimulants and nourishment. Some surgeons recommend, instead of the application of nitric acid, that the tissues should be freely destroyed with the actual cautery.

Dr. Goldsmith, of the United States, speaks highly of bromine as a local application to arrest the sloughing; and others have recommended carbolic acid, iodine, oil of turpentine, and strong chlorine water with the same object. It frequently happens that more than one application will be required should the patient survive, and the operation should be performed under the influence of an anæsthetic in order to do it thoroughly. T. PICKERING PICK.

HOSPITALISM and HOSPITAL MORTALITY.—For a long time surgeons had been convinced, each one from his individual experience, that the mortality among cases in hospital was excessive as compared with that among patients treated in private. Up to 1870, indeed, many hospitals were almost plague-stricken, especially those of cities; the mortality after all major amputations being 1 in 2–3, and due chiefly to septic disease. The experience of lying-in wards, and of ovariotomies in general hospitals, showed the existence in these of some very fatal influence, for the detection of which the puerperal uterus and the peritoneum seemed to be the most delicate instruments. No attempt, however, was made to reduce to figures the difference in mortality after operations within and without hospital walls until Sir J. Simpson published papers on the subject in 1869.

Before going further, attention should be drawn to the fact that in 1869 small country and cottage hospitals were rare. The frightful mortality above-mentioned was calculated from the statistics of hospitals in the large towns of Great Britain and the Continent, and existed in them only at that time; fortunately such a state of matters is now a thing of the past, and young practitioners know nothing of it.

As the standard of comparison Simpson selected amputations through bones (those through joints being excluded for the sake of simplicity), because their frequent occurrence rendered possible the collection of large numbers of cases both in and out of hospital; the amount of operative skill required put country practitioners and hospital surgeons more on a level in this respect, and the similarity of the causes for which those operations are performed, and of the condition of the subjects of them in hospitals and in the country, justified the comparison of the two series of cases.

From eleven large hospitals in London, Edinburgh, and Glasgow, Simpson collected 2,089 cases of amputation through the bones of the thigh, leg, arm, or forearm; of these, 855 died, giving a mortality of 1 in 2·4 (in each case the statistics included those for 1868 and the preceding years).

Simpson also sent schedules to a large number of practitioners resident in districts where accidents were common, requesting each to record *all* his amputations under headings of 'injury' and 'disease,' in each case noting the number of deaths. The results obtained showed that of 2,098 cases of all kinds, 226 died, or 1 in 9·2.

At least 23 of the cases were double, and of these only 7 died, in 3 of which one thigh, and in 3 both thighs were removed. The mortality even in these cases was only 1 in 3·03. It appeared, further, that of 22 amputations between 70 and 84 years, 8 died, or 1 in 2·7, the mortality being less than that for amputations at all ages in general hospitals. There is every reason to believe that had the operations been done by men of experience, the results would have been better still, for the results of each practitioner improved with the number of amputations performed.

It was evident from the numbers of amputations at different heights, and from remarks appended, that there was no material difference in the severity of cases in the two classes: thus, among the country cases were 313 primary amputations of the thigh, with 80 deaths, or 1 in 3·91; whilst in the hospital list were 304 cases, with 196 deaths, or 1 in 1·57. It is probable, indeed, that the conveyance of these severe injuries to hospitals told considerably against the patients. The remarks showed that many cases included in the country list, and which ultimately did well, were not sent to hospital simply because they appeared so bad that to carry them any distance would have been fatal. Lastly, very few of the amputations in private were done among the upper class of society—8 to 10 per cent. of the whole were done among the middle class, and the vast majority upon artisans, miners, labourers, &c.; so, as regards social position, the two classes are strictly comparable. Much has been made of the probability that the country patients were in ruder health at the time of operation than those admitted into great hospitals; but no inconsiderable proportion of amputations done in London, even, comes from country districts, and feeble constitutions, debauchery, and inattention to domestic hygiene are not unknown in the country. Even in this respect, therefore, the two series of cases do not differ much.

It should be noted that, in the country statistics, Simpson seems to have made all doubtful cases tell against them; e.g. an amputation was said to have done well, but the patient died of phthisis three months later—it was counted as a fatal case.

It may therefore be taken as approximately true that, at the period of which we are speaking, the mortality after amputations for all causes was almost four times as great in large hospitals as in the country. Though no similar comparison of the results of other operations has been made, there is no reason to doubt the truth of the conviction which was widely held, viz. that every patient with an open wound was safer out of hospital than in it, even though he should be placed under circumstances immeasurably inferior as regards surgical skill, nursing, housing, and feeding.

This difference in results led to the belief that certain conditions in hospitals engendered disease, and the word '*hospitalism*' was invented by Simpson to express those peculiarities of hospitals which produced such fatal results. The exact meaning of 'hospitalism' will, however, be found, by comparing the *causes of death* in the two classes, and seeing which produce the excessive mortality in hospitals.

The cause of death was stated in 160 of the 227 fatal private cases; these, at a mortality of 10·8 per cent. among 2,098 patients, correspond to 1,478 patients. In the following table the number of deaths per cent. (calculated upon this number), produced by the chief causes are shown; and, side by side with them, similar results from a series of 200 amputations through bones, with 49 deaths (24·5 per cent.), performed at University College Hospital from 1871 to 1881 inclusive:—

PRIVATE—1,478 cases.

Cause	No. of cases	Per cent.
Shock	63 . .	4·05
Internal injuries. . . .	13 . .	0·87
Exhaustion	28 . .	1·89
Pyæmia	8 . .	·54
Septicæmia	0 . .	·00
Tetanus	11 . .	·74
Gangrene of stump . . .	18 . .	1·20
Secondary hæmorrhage .	9 . .	·60

UNIVERSITY COLLEGE HOSPITAL—200 cases.

Cause	No. of cases	Per cent.
Shock	10 . .	5·00
Internal injuries. . . .	1 . .	0·50
Exhaustion	4 . .	2·00
Pyæmia	12 . .	6·00
Septicæmia	9 . .	4·50
Tetanus	0 . .	0·00
Gangrene of stump. . .	3 . .	1·50
Secondary hæmorrhage .	0 . .	·00

Other causes in each series produced 1–2 deaths each.

Erichsen states that the amputation-mortality at University College Hospital has been pretty constantly a little above 25 per cent, and although of late years the mortality from septic disease has been much diminished, from the successful employment of antiseptics, other causes have kept up the mortality almost to the same point. Whilst yielding the same total mortality then, the statistics of University College up to 1868 (could they have been obtained) would have brought out still more strongly the chief difference between the above tables, viz. the difference in mortality from septic disease. The best way to arrive at this is probably to add together the mortalities from pyæmia, septicæmia, and exhaustion; for under the latter heading were formerly placed many cases of acute and chronic septic disease. The cases which may fairly be entered under the head of exhaustion will balance each other. We thus find that the mortality from septic disease in private is 2·40 per cent., in hospital 12·5; in other words, the mortality from septic disease in University College Hospital during the last 11 years has been 5·14 times greater than it was among private cases 15 to 20 years ago. And this is not putting the case as strongly as it might be put by any means. The general result of the discussion at the Clinical Society in 1874 on 'pyæmia in private practice,' pointed to a similar conclusion; though it is right to state that a few surgeons, and especially Sir J. Paget (who had seen 3 cases of hospital gangrene in private, at different times and apparently not due to infection from hospital cases), expressed their belief that septic disease was not specially common in hospitals.

Causes of Hospitalism.—Why were septic diseases so much commoner in hospitals than in country cottages? What were the differences in the conditions of the two classes of patients? The first is that private patients were treated apart from each other, in cottages which probably never before contained a surgical case, and by men who may not have had another case with an open wound under their care at the time—certainly not a case of infective wound disease, unless it were erysipelas. Next, the almost constant remark concerning the dwellings in which the patients lived was that the ventilation was of the freest, through broken windows, &c.; they were either one- or two-roomed, and by no means remarkable for cleanliness. The conditions were therefore strongly opposed to infection from any case of wound-disease. But simple putrefaction of the discharges probably occurred in every case, and it is more than likely that, in spite of the draughts, many patients suffered at night from simple overcrowding.

On the other hand large hospitals had for generations contained numbers of septic wounds, and many of the sufferers had died of septic disease, so that any virus which such cases could leave behind them would certainly have been left. The wards were often 'close' from simple overcrowding; and at dressing time, if at no other, an odour of putrefaction arose from the wounds. Isolation of existing cases of septic disease, even erysipelas, was not uniformly practised; and disinfection after the death or recovery of such a case was by no means perfect, if attempted. The same surgeons, dressers, and nurses tended the patients, and in passing from one to the other the hands were not cleansed, unless distinctly soiled. Sponges used promiscuously among the patients were ready carriers of infection. Lastly, when septic disease started in hospitals, the conditions giving rise to it often went long undisturbed and unchanged; thus certain beds maintained bad reputations and added considerably more than their share to the general mortality.

Now, assuming that erysipelas, hospital gangrene, septic infection, and many, if not all, cases of pyæmia are mildly infectious, and certainly contagious or inoculable, no conditions can well be imagined more favourable than the above either to the spread or to the preservation of their seeds. Infection and contagion doubtless explain a great deal of the excessive mortality of hospitals; as is shown by the immediate diminution of mortality in lying-in hospitals after insisting that the nurses should wash their hands in carbolic-water after attending to each patient, or upon causing each patient to attend to herself and to use clean wool (which is immediately burnt) instead of sponges.

It is impossible to say exactly how much of the excessive mortality of hospitals is due to simple infection; but it is held by the majority of surgeons that pyæmia, septic infection, and hospital gangrene actually arose with special frequency in hospitals. *The* condition which chiefly favours them is overcrowding of septic wounds. In civil hospitals again and again the best surgeons have noticed that when the amount of suppuration in their wards rose above a certain point, septic disease broke out. Again, the common experience in times of war is that cases admitted into the hospital at first do well; but ten to fourteen days after a battle, when the hospitals have become crowded with wounded, septic disease appears and empties many a bed; and this in churches, barns, and similar buildings which never held a septic case before. As a rider to this, it must be added that where overcrowding is almost impossible—as in the open, in tents or lightly constructed huts—septic disease is slight or absent.

Thus, overcrowding of wounds does seem to exercise a powerful influence in the production of septic disease. But wounds are not essential, for overcrowding of typhus patients may cause pyæmia to appear among them. Overcrowding first prevents a free supply of air from acting upon the virus of these diseases, pure air diluting and being apparently destructive of such contagia. Next, it greatly lowers the health of patients, by causing them to breathe air containing excess of carbonic acid, and of organic bodies leaving the body by the respiratory and other channels; and it thus acts as a predisposing cause of septic disease, like all weakening influences. Finally, overcrowding would seem to have its effect upon the development of the viruses of these diseases, by means of something arising from the septic wounds in surgical hospitals.

All recent research tends to show that these diseases are due to the action of locally or generally infective organisms. Koch was able to obtain from putrid fluids organisms which produced in mice diseases similar to the pyæmia, septic infection, and hospital gangrene of man; and, as he worked in Wollstein, where it was impossible to obtain material from septic diseases to experiment with, this would mean that the organisms of these diseases exist almost everywhere, and that they find putrid fluids a suitable nidus. But, as the discharges of all wounds in former times became septic, each wound would have contained the poisons of perhaps all three hospital scourges; nothing but conditions preventing their entry from the wound, or their development after entry in the system, would save the patients from dying of them; and the effect of overcrowding would be limited to destroying these barriers by enfeebling the patient. But this is certainly not its sole effect. It seems most probable, indeed, that the causes of pyæmia, septic infection, and hospital gangrene are more numerous—as are all organisms—in great centres of human activity; but that they have to undergo some change, some increase of virulence perhaps, before they can invade the body and produce these diseases. The aggregation of septic wounds tends strongly in some unknown way to favour this development; but it is not essential to it, the development taking place apparently under other circumstances, though much less commonly. It is, however, impossible to speak with any certainty on this matter until the poisons of the diseases have been isolated and their life-history ascertained.

Prevention of Hospitalism.—Until the etiology of septic disease is cleared up, action must be taken on the hypothesis that, in at least 99 cases out of every 100, disease of this type is due to the invasion of the body by micro-organisms from a septic wound.

The first point to attend to is the prevention of overcrowding. The amount of carbonic acid in the air is taken as the index of impurity, the deleterious organic matter from the lungs varying directly with it. Normally air contains about ·4 of carbonic acid per 1,000 cubic feet. If the quantity rises above ·6 the room gets 'close.' To prevent this, it is calculated—from the average quantity of carbonic acid given off by an adult in an hour—that at least 3,000 feet of air should be supplied per hour for each adult; 3,500 to 4,000 feet will therefore be required for a case with a septic wound. This amount must be supplied without draughts, which can be effected only by giving each bed a cubic space of 1,800 to 2,000 cubic feet, the height being about, but not more than, 12 feet. As much space as possible between the beds should be given. Provision must be made for the removal of stale and the supply of fresh air at the stated rate, open windows and cross ventilation being used as much as possible.

Whenever it can be managed, a ward should be emptied and thoroughly cleaned and ventilated for a week after three months' use.

The clothes of patients should not be placed, in their frequently filthy condition, beneath the beds.

Secondly, with regard to wounds, these should be rendered and kept aseptic wherever possible. When this is impossible, no discharge should be allowed to accumulate and decompose in the wound, but it should be drained off and immediately disinfected by the dressing. No one should pass from one case to another without purifying his hands with an antiseptic solution—mercuric chloride, 1 per 1,000, being the best.

Foul cases—e.g. large ulcers, moist gangrene, incontinence of urine or fæces—should not be admitted to the general surgical wards.

Thirdly, should a case of septic disease occur, it should be isolated as soon as recognised, together with bed, bedding, and all belongings; and the ward round about well washed with bichloride of mercury solution (1 in 500) or carbolic lotion. This is especially necessary with erysipelas and hospital gangrene. No communication should take place between the attendants upon ordinary and upon septic cases. The freest ventilation should be provided in the infectious ward.

Upon the recovery or death of the patient, the straw of the mattress should be burnt and the rest of the bedding disinfected thoroughly. The iron bedstead should be taken to pieces and well washed with carbolic or mercuric lotion. If the patient returns to the ward he should first have a bath containing carbolic acid (1 in 40), or bichloride of mercury (1 in 1,000).

None of these precautions should be neglected, but least of all the prevention of putrefaction in wounds, this being so favourable to the development of the organisms of septic disease. Every hospital now-a-days shows the results of antiseptics, though 'Listerism' may not be practised. No more striking example can be given than that offered by Lister himself when introducing the subject. The male accident wards of the Glasgow Infirmary were decimated by septic disease, the surroundings of the hospital being truly awful (*Lancet*, Jan. 1, 1870, p. 6). The mortality among Lister's own amputations was 1 in 2·2; after the introduction of antiseptics it fell to 1 in 6·6 (3 years' experience.) During this time two died of pyæmia, in one of which the disease was contracted before amputation, and in the other the dressing became septic. Here there was absolutely no other change, and the cases were treated by the same hand. Other hospitals, especially some German ones, tell the same story; so that now we have much less use for the word 'hospitalism.'

Stanley Boyd.

HOUSEMAID'S KNEE. *See* Bursæ, Affections of.

HOWSE'S SPLINT for excision of the knee is a metal splint roughly resembling McIntyre's splint, but the thigh and leg pieces do not reach so near to the knee, and instead of the hinge behind the joint there is a rigid metal bar about two inches wide. At the distal extremity of the splint there is a pulley which revolves transversely; the limb is suspended from this pulley, which allows rotation of the limb when the patient shifts his position, and so protects the knee from jarring. The limb is fixed to the splint by waxed bandages, and the intervals between the limb and the splint are packed with cotton wool soaked in melted wax and paraffin, which prevents the discharges trickling between the limb and the splint.

Bilton Pollard.

HUMERUS, Dislocations of the. *See* Shoulder, Dislocations of the.

HUMERUS, Fractures of the.—Fractures of this bone fall into three groups—(*a*) those of the upper end, (*b*) of the shaft, (*c*) of the lower end. In group (*a*) are fracture through the anatomical neck: splitting off of the greater tuberosity: separation of the epiphysis (a block including the head and the two tuberosities): and, a little lower down, fracture through the surgical neck. These injuries are generally the result of a fall on the shoulder or other direct violence, though they are occasionally produced by falls on the elbow or hand.

Fracture exactly in the line of *the anatomical neck*, if complete, would isolate the head, and might be expected to lead to its necrosis. Such a result, however, in simple fracture, has not been observed, either because separation has not been absolute, or because some of the capsule has remained attached to the upper fragment, and has sufficed to maintain its nutrition. This fracture is often impacted. In some cases the upper fragment is more or less rotated, and has even been found turned round, so that its cartilaginous surface presented towards the shaft, in the cancellous tissue of which it was firmly embedded; or the head may even be driven out through the capsule into the axilla. Exact diagnosis, especially if swelling is great, may be impossible. There may be crepitus, with absence of the signs of fracture in other parts, and loss of free movement between the smooth surfaces of the joint. Occasionally the head is felt not moving with the shaft when the arm is rotated, or the upper end of the bone feels abnormally wide. In impacted fracture there is slight shortening, slight flattening of the shoulder; the smooth movements of the head in the glenoid cavity are not felt; the upper end of the shaft is slightly drawn up towards the acromion.

Fracture of the greater tuberosity has several times been verified by dissection; but the injury is almost invariably associated with dislocation of the humerus beneath the coracoid process. Some, however, maintain that it occurs alone, either from direct violence or from the sudden action of the muscles inserted into this process. For its treatment (after reduction of the dislocation of the head, should this be present), nothing would be required beyond keeping the arm at rest by the side.

Separation of the epiphysis is not met with after the age of about twenty. When it occurs, the head is felt in the glenoid cavity, but it does not rotate with the rest of the bone. The upper end of the shaft is drawn inwards and upwards beneath the coracoid, where its smooth outline, contrasting with the jagged shape of an ordinary fracture, can be felt. The elbow is slightly withdrawn from the side, and pointed slightly backward.

Fracture of the surgical neck is much more frequent than the injuries already mentioned. Its seat may be at any point between the tuberosities and the insertion of the teres major, a space of about two inches. It is generally transverse, and not rarely impacted, the shaft being driven into the upper fragment. The upper fragment is often rotated through a quarter of a circle, or more, by the muscles inserted into and acting with great leverage upon it; the shaft is drawn, by the muscles attached to it, inwards towards the axilla, where its small irregular end, quite unlike the head, may be detected. There may be shortening, but this is seldom marked; there is flattening of the shoulder; the head does not rotate with the shaft unless there is impaction; and crepitus is detected when the ends are brought into contact.

Treatment.—If there is impaction, care should be taken not to break the connection between the fragments. A pad must be placed in the axilla, and the arm, hanging down, must be bandaged to the side, the forearm lying across the chest. When there is no impaction there is great difficulty alike in adjusting the fragments and in maintaining them in position, the more so because swelling is often considerable. Reduction here, as in separation of the epiphysis, may sometimes be effected by carrying the limb perpendicularly over the head, and manipulating the fragments in this position, and then bringing down the arm while extension is steadily continued. After reduction a pad is placed in the armpit, and a splint of leather or gutta-percha is moulded over the shoulder and arm; towards this splint the upper end of the lower fragment is drawn—that is, outwards—by a carefully applied bandage. The elbow is then bandaged closely to the side, so as to throw the upper end of the lower fragment still further outward. Or, as Erichsen suggests, a piece of leather, two feet long and six inches broad, may be bent at its middle and applied, the one half to the chest, the other to the inner aspect of the arm; the rounded bend, which must be carefully padded, being well pressed up into the axilla. The elbow is then bandaged to the side.

Fracture of the surgical neck is sometimes associated with *dislocation of the head* of the bone into the axilla, or forwards under the coracoid process. This injury is easily mistaken for ordinary dislocation. But on careful examination the following symptoms will be detected:—The shoulder is flattened, and a hollow beneath the acromion shows that the head has left the glenoid cavity; the head is felt in its abnormal situation; no movement, however, is communicated to it when the shaft is rotated; the width of the shoulder from before backwards is increased; the arm is shortened, and the upper end of the shaft may sometimes be felt as a rough projection beneath the deltoid. Crepitus may perhaps be detected when the arm is extended and rotated.

Treatment.—An anæsthetic should be given, and, if possible, the head should be replaced in the glenoid cavity by extension and manipulation. The fracture should then be put up in the manner described above. In several recorded cases reduction has been easily effected. Should the attempt, however, fail, the shaft may be pushed up into the glenoid cavity to form a false joint. Or the fracture may be put up with the head unreduced, and when union has taken place an attempt at reduction may be made. This, however, is very little likely to succeed, and all that is possible will be to break down adhesions, and restore some degree of movement, as in an ordinary case of unreduced dislocation. In such instances it is best to give the patient a written statement of the nature of his injury, so that his case may not subsequently be mistaken for an uncomplicated dislocation, and be treated from that point of view.

Fracture of the shaft is more frequent in the lower than the upper half. It is due either to direct violence; to falls on the hand or elbow; or (and this more often than in any other bone except the patella) to muscular violence. The fracture is generally oblique, in a direction downwards and outwards, but not rarely it is transverse. The *symptoms* are plain: loss of power, mobility when the two fragments are separately grasped, and crepitus. In oblique fractures overlapping may be considerable. The deltoid, in fractures below its insertion, may cause troublesome displacement by tilting the upper fragment outwards. Ununited fracture is much more common in the shaft of the humerus than in any other of the long bones.

Treatment.—After adjustment has been effected, four splints of appropriate length, and wide enough in the aggregate to exactly enclose the limb, are applied so as to surround it, and are fixed by broad pieces of strapping and a bandage. The forearm, placed at a right angle, should be securely bandaged across the chest. Some surgeons use a rectangular splint, extending along the inner aspect of the arm and forearm, with three short accessory splints for the purpose of defending the fracture from disturbance by movements of the forearm, which they regard as the chief cause of non-union. Extension (in order to prevent shortening) has been attempted in various ways, among others by applying weight-extension (in the usual manner), but with no very satisfactory result. Union should be firm in from thirty days in the young, to forty or forty-five in older persons, and it must be carefully tested before the splints are discarded. The arm is useful even where union takes place with considerable deformity. The large vessels generally, but not always, escape injury. Paralysis may occur from pressure on the nerves, especially the musculo-spiral, resulting from exuberant callus. *See* NERVES, Injuries of.

Fractures of the lower end are divided into those which are external to, and those which involve the joint—an important distinction in respect to the future utility of the limb. The first group comprises transverse fracture just above the condyles; separation of the epiphysial block; and detachment of either of the condyles. The second group includes T-fracture, consisting of a transverse break just above the condyles, accompanied by a vertical fissure separating the two condyles from each other; and an oblique fracture, detaching a fragment of variable size, composed of one or other of the condyles, and a corresponding portion of the articular surface. All these injuries are much more common in the young than in adults, while separation of the epiphysis does not occur after about the eighteenth year. They are apt, particularly those which directly involve the joint, to be followed by impairment of movement in the limb, a fact of which it is best that parents, at the outset, should be informed. They are usually produced by falls on the elbow, or, more rarely, on the hand.

Fracture across the bone, just above the condyles, may be directly transverse; but it is generally oblique, the line passing upwards and backwards. Occasionally it runs upwards and forwards. The appearances caused by this injury are very similar at first sight to those of dislocation of the bones of the forearm backwards, and the likeness is still more deceptive when the latter accident is combined with fracture of the coronoid process of the ulna. The olecranon projects backwards under the action of the triceps, and the tendon of this muscle stands out in strong relief; the forearm looks shortened, and the lower end of the humerus is prominent anteriorly. A correct diagnosis, however, is easily arrived at. In dislocation the humerus is found to be entire, the two condyles lying, as they should, in the long axis of the shaft, while the olecranon has been separated from them and carried backwards. In fracture of the humerus the condyles are parted from the shaft, and have followed the olecranon backwards. In dislocation there is limitation of mobility, the soft structures are tense, and some force is required to effect reduction, but when this has once been effected it is permanent; while in fracture of the humerus the parts are less fixed and less tense, and reduction is very easily effected, but deformity returns when extension is withdrawn. The same recurrence of deformity is observed when the coronoid process is detached, but the condyles of the humerus are found in their normal relation to the shaft.

Treatment.—In transverse fracture above the condyles reduction is easily effected by drawing the radius and ulna forwards, while the shaft of the humerus is steadied by an assistant. A firm gutta-percha or leather splint, bent to a right angle, is then moulded to the whole length of the posterior aspect of the arm, elbow, and forearm as far as the wrist; and a well-padded short splint is applied to the front of the arm to prevent projection of the upper fragment forward. These are secured by wide pieces of strapping and a bandage. When, as is often the case, there is considerable swelling, the limb must be placed in an elevated position on a pillow, and evaporating lotion used until the appliance referred to can be borne; in the meantime, if there is any marked tendency to displacement, the limb should be secured by light bandaging on an inside rectangular splint. In three weeks, the lower end of the humerus being firmly held, gentle passive movement of the elbow should be employed. The splints may be discarded in from three weeks to a month in young subjects; in adults they should be continued for five weeks.

Separation of the epiphysis must be treated in a similar manner. Displacement is usually slight, and the fragments are easily kept in place by the splints mentioned above. Gentle passive movement should be practised at the end of a fortnight. The tip of the internal condyle is sometimes knocked off by a fall on the elbow, or detached by the action of the muscles arising from it. The fragment can generally be felt to be displaced, and can be moved when grasped. Crepitus may sometimes be detected, and there is pain when the patient attempts to flex the forearm. The separated piece may, in some cases, be maintained in place with strapping and a pad ; but even if this cannot be done, ligamentous union occurs, and no impairment of the arm is likely to remain.

Fractures of the lower end of the humerus, entering the elbow-joint, are always serious. It is difficult alike to adjust the fragments and to keep them in position. The contour of the articular surfaces is apt to be permanently changed; and the inflammation which follows the injury leads not only to the formation of articular adhesions, but to the production of a large amount of callus, by which the movements of the joint are in great part or entirely prevented. Usually considerable swelling follows quickly on the accident, and interferes both with exact diagnosis and with the necessary treatment.

In ⊤ fracture all these drawbacks present themselves. Not only is there displacement backwards, but the olecranon is apt to be wedged up into the line of fracture between the two condyles, with the result of spreading them from each other and increasing the transverse diameter of the joint. This relation of the fragments to each other it may not be possible to correct, while, especially in young subjects, the callus thrown out from the broken surfaces and the surrounding soft parts converts the lower end of the humerus into a shapeless mass, against which the radius and ulna become firmly locked. At once, or as soon as swelling has sufficiently subsided under the influence of position, rest, and cold lotions, adjustment must, as far as is possible, be accomplished, an anæsthetic being, if necessary, used. To facilitate reduction, the forearm, bent at a right angle with the arm, should be pressed downwards for the purpose of disengaging the ulna from between the fragments, which must then be manipulated in whatever direction is indicated by their displacement. The joint should be placed at a right angle, not only to relieve tension, but in view of the stiffness which is likely to ensue. The most convenient splints are those recommended above for transverse fractures above the condyle; but a rectangular inside splint for the arm and forearm may be used. Any improvement in the position of the fragments that may be possible must be secured by further modelling; but little in this direction can be done after about the twelfth day. Passive movements should be commenced, in children, not later than the twentieth, in adults not later than the thirtieth day, and be regularly continued as long as they are found to increase the range of motion in the joint; but the condition of the fragments, as to their firm union, must first be carefully observed. In some cases movement may be improved at a later period, and when some of the callus has been absorbed, by breaking down adhesions under an anæsthetic; but no great force ought to be employed. Should the joint have become fixed at an inconveniently obtuse angle, there is no objection, if it can be done without much violence, to bending it up to within a right angle. For the diagnosis and treatment of oblique fracture of either of the condyles extending into the joint, the rules, modified according to particular cases, are the same as those just stated for ⊤ fractures. Howard Marsh.

HYDATIDS.—In considering this subject from a surgical point of view, attention will be chiefly directed to symptoms, diagnosis, and treatment. It may, however, be well at the onset to briefly recall to mind some of the main features of the pathology.

The formation of an hydatid results from the ingestion of the eggs of the tænia echinococcus—a tape-worm found in the upper small intestine of the dog. The embryo, when liberated in the human stomach by the disintegration of its egg-shell, bores into or through the gastric walls. In the majority of cases it then enters the blood-vessels and is carried by the blood-stream to the various organs and vascular tissues of the body, not one of which is exempt from its invasion. The organ most frequently attacked is the liver; possibly, as Dr. Thomas suggests, because the hepatic capillaries are the first to arrest the onward progress of the embryo. Should it run the gauntlet of these, the pulmonary capillaries act as the obstruction, and consequently the next most frequent seat of the disease is in the lungs. In a fully-formed hydatid three layers may be described as composing the cyst-wall. The outermost layer, called the adventitia, is tough, fibroid, and very vascular. It is not, however, a part of the true hydatid, but is formed of the tissue in which the parasite lies. The minute embryo acts as an irritant, and induces proliferation of the cells of the surrounding connective tissue; as it enlarges, the cells are subjected to pressure, and become arranged round it as a capsule. Blood-vessels from the adjoining healthy tissues enter this capsule, which is thus gradually organised into a fibrous membrane. This adventitious layer varies in thickness according to the amount of initial irritation and the position of the hydatid; in some structures it would appear never to be formed at all. Thus, Professor Allen, of Melbourne, has reported several cases of hydatids in serous cavities perfectly devoid of adventitia. It is, however, usually present, and is always very vascular. The vessels on its smooth, inner surface are dilated and varicose—a fact to be constantly borne in mind by the surgeon.

Within the adventitia, and in close contact with it, is the true hydatid sac. It has a greyish, gelatinous appearance; it is translucent and highly elastic. When punctured, the contained fluid is evacuated under considerable pressure, and the cyst collapses, falling in folds from the adventitia with a peculiar tremulous movement.

The outermost layer of the *true cyst* (ectocyst of Huxley) is tough, thick, highly elastic, and laminated. The inner layer (endocyst or germinal membrane) is thin, delicate, and cellular. The contained fluid, when healthy, is limpid and transparent, and has a peculiar faint and earthy odour. It is neutral or alkaline in reaction, and of low specific gravity, 1005–1013; it contains an excess of chloride of sodium, but no albumen. Some small hydatids consist merely of the cyst filled with this fluid; such are called acephalocysts. In most cysts, however, and certainly in large ones, echinococcus heads or scolices are to be found. Small cysts, termed 'daughter cysts,' are sometimes formed within the main cyst, and these in turn may contain 'granddaughter cysts,' resulting in what is known as the 'pill-box' hydatid.

Symptoms and Diagnosis.—When an hydatid is sufficiently near the surface of the body to be recognised, it appears as a painless swelling, slowly increasing in size, but giving rise to no inconvenience except by reason of its bulk. Occasionally, as a result of pressure on neighbouring structures, or of changes in the cyst, certain symptoms may arise. Thus severe gastralgia, attended with attacks of syncope, has been noticed in cases where a large cyst projected from the under surface of the left lobe of the liver, and possibly pressed on some neighbouring sympathetic plexus. Vomiting and other dyspeptic symptoms may be the result of direct pressure on the stomach. The cyst may be even so large as to encroach upon the thorax and impede respiration. Jaundice, ascites, and anasarca may be induced by pressure on the hepatic duct, vena portæ, and vena cava respectively. When in the lung the presence of the cyst may excite cough, dyspnœa, and hæmoptysis. Again, a cyst may inflame and suppurate, and so become practically an abscess, and be attended by constitutional symptoms. Finally, a cyst may be ruptured by external violence. Such a rupture into the peritoneal cavity is attended with agonising pain and intense collapse; the case probably ending fatally. In the lung the rupture is less dangerous, the cyst or cysts being coughed up, although suffocation is not uncommon from the glottis being firmly plugged in the patient's effort to expel the cyst. Even in cases where the cysts have been successfully expectorated, recovery is often slow, as a more or less severe broncho-pneumonia is apt to supervene.

Physical Signs.—The sensation imparted to the fingers of an expert manipulator by palpation of an hydatid tumour is characteristic, and is often an infallible guide to diagnosis. The tumour presents a smooth, uniform, rounded contour; it is elastic and tense, and not at all tender. Fluctuation may generally be obtained. Percussion elicits a clearly defined area of absolute dulness, and in some cases also the peculiar and characteristic thrill known as hydatid fremitus. This is felt in large cysts filled with daughter-cysts, and is probably produced by the concussion of these with each other.

With regard to the differential diagnosis of hydatids, so much depends upon the situation of the tumour that it would be impossible here to enter into special details. Hydatids in the abdominal cavity may be confounded with hepatic abscess, a dilated gall-bladder, malignant growths, renal cysts, uterine and omental tumours, or aneurism. With all these conditions there is either constitutional disturbance or some special symptom which is never present in hydatids. Hypertrophy of the spleen and hydatid of that organ are sometimes mistaken for each other; but the tough, unyielding feel, and the detection of the splenic notch, especially if the condition be associated with anæmia and dropsy, will help to distinguish the former from the tense, elastic, and even hydatid cyst. From an ovarian monocyst the diagnosis of a very large, thin-walled hydatid is not always easy, as there are many characters in common. Attention to the mode of growth—the ovarian from the flank displacing the intestines upwards, whilst the hydatid generally pushes its way from above downwards—may be of service. The careful examination of the fluid obtained by exploratory puncture should be decisive. Hydatids in the lungs may be confounded with phthisis, pleuritic effusion, localised empyæma, and malignant growths. These, again, are usually distinguished by constitutional symptoms. Dr. Bird, in his work on *Hydatids in the Lung*, enters fully into this matter.

Treatment.—Various drugs, such as iodide of potassium, tincture of kamala, and turpentine, have from time to time been recommended as capable of arresting the progress of an hydatid growth or of killing the parasite; electrolysis, also, has been much lauded. The success of these remedies, however, appears to be equivocal; the curative treatment of hydatids is to be regarded as a purely surgical matter.

The disease sometimes undergoes natural cure. The hydatid itself is non-vascular, and derives its nourishment by a process of imbibition from the vessels of the adventitia; this may undergo contraction, and the calibre of its blood-vessels is diminished to such an extent that the hydatid dies from gradual starvation. The adventitia goes on contracting, and sometimes becomes cartilaginous, or even calcareous in places.

Occasionally the daughter-cysts proliferate to such an extent, and become so tightly packed inside the parent cyst, that they are, so to speak, crushed to death. They then degenerate, become opaque, and fuse into a solid mass, which may caseate. These processes, however, are so slow that the life of the hydatid is as a rule longer than that of the patient. The treatment of an ordinary hydatid of moderate size, when possessed of an adventitia, and situated in the substance of an organ such as the liver, spleen, or lung, consists in tapping the tumour with a long, fine syphon-trocar; the fluid is drawn off, and the canula is removed when the cyst is nearly emptied. The result of this procedure is that the hydatid cyst collapses and falls away from the adventitia, and serum exudes from vessels to fill the space thus formed. This fluid is usually absorbed in a few days, and the adventitia then gradually contracts. The cyst may or may not undergo degeneration. The writer, when examining the bodies of persons who had died from other causes, years after being tapped for hydatids, has found cysts almost unchanged, lying simply folded up inside a cavity, and still remaining within the adventitia.

The simple operation described above is, as a rule, free from danger; now and then, however, alarming symptoms supervene. A few precautions are necessary to diminish the risk of their occurrence:—the trocar used should always be a clean and long one, with an accurately-fitting canula; the cyst may be much deeper than the surgeon thinks, and, if the trocar be long enough only just to reach the sac, it may push the adventitia away from surrounding tissue, and so entail an extravasation of hydatid fluid and blood. Some surgeons prefer to use the aspirator; but this involves the risk of exhausting the receiver to such an extent that the dilated vessels of the adventitia may be ruptured, and a dangerous and even fatal hæmorrhage may follow. In tapping a pulmonary hydatid the course of the large bronchi should, as far as possible, be avoided; this is best done by introducing the trocar at the side of the thorax midway between the sternum and spine, and keeping it as nearly as possible parallel with the direction of the main bronchi. The simple introduction of a trocar deeply in the epigastrium has at times been followed by intense shock and collapse lasting for days, probably from some injury to the solar plexus. Slight febrile disturbance occasionally follows the tapping; and, when the operation is performed on an abdominal hydatid, a mild attack of urticaria, known as the 'hydatid rash,' may supervene. This is the result of the extravasation of a little fluid into the large serous cavity; the rash generally subsides on the second day. Occasionally it is necessary to tap two or three times before the parasite succumbs. Inflammation and suppuration of the cyst may follow the operation; they must be met by active treatment. Cases of hydatids in the pleural cavity require careful watching after tapping. Should the temperature rise and the area of dulness suddenly increase, a free incision must be made into the cavity, and thorough drainage established until all cysts and débris are evacuated.

When a cyst has very thin walls, and is freely movable in the abdominal cavity, tapping may prove a dangerous procedure. In these cases there is a probability of the adventitia not being properly formed, and when tapped the fluid is not only liable to be extravasated into the peritoneal cavity, but the collapsed cyst itself may die from malnutrition, and determine a fatal peritonitis.

The plan of treatment the writer has found most successful in these cases is to secure adhesion between the visceral and parietal layers of the peritoneum prior to tapping. This is accomplished by inserting about a dozen harelip pins, with flat heads, through the abdominal parietes into the tumour in a circle round the site of puncture, and then carefully supporting the abdominal walls with strapping or a bandage. At the expiration of from eight to ten hours these pins are removed, the tumour tapped with a fine syphon-trocar and canula, the patient being kept at rest in bed for some days subsequently.

When the cyst is very large adhesions may exist, and the tumour can then be tapped in the ordinary way. But this simple treatment will seldom be successful in such cases, especially if daughter-cysts be present; the sac will require free incision and drainage. This is best performed as follows:—A suitable site for tapping having been selected, adhesion is obtained between the opposed serous surfaces by the use of harelip pins in the manner already described. Then an incision of an inch or more in length is made through the skin, and a full-sized trocar, such as is used in veterinary surgery, is plunged into the tumour, the canula being left in and secured with tapes. The fluid, cysts, and débris are allowed to flow away, and the cavity is washed out twice a day with a tepid antiseptic solution. On the third day the canula is removed and a large india-rubber tube is inserted in its place.

The opening thus made is gradually dilated until the finger—which is by far the best kind of probe—can be easily introduced into the cavity. By this method daughter-cysts, and in some instances even the mother-cyst, may be removed. A very convenient aid is a light steel hook attached by a spring to the pulp of the index finger. These cases are often tedious, the suppuration being sometimes profuse before the mother-cyst and débris have entirely come away. The patient's strength requires support by nourishing and easily-digested food and by fresh air. In the end these cases usually do well.

When a cyst is very large, and movable in the abdominal cavity, possessing but few adhesions and appearing to contain many daughter-cysts, the safest mode of treatment consists in the entire removal of the whole tumour by abdominal section. This operation is generally a complete success. A suppurating hydatid must be treated like an ordinary abscess. Adhesions will generally exist, but if not they must be established, and then the cavity may be freely opened and drained.

When an hydatid in the substance of the liver has been treated by drainage, a biliary fistula is occasionally established which it is difficult to close. The writer in such cases has had good results from the use of the galvanic cautery, a coil of platinum wire, properly insulated, being introduced into the fistulous track.

To sum up, the surgical operations required for the cure of hydatids are four in number, and may be classified thus:—

I. For moderate-sized cysts in solid organs, the minor operation of simple tapping with a fine syphon-trocar.

II. For movable cysts with thin walls, the medium operation of establishing adhesions, drawing off the fluid, and removing the canula.

III. For very large adherent cysts filled with daughter-cysts, the major operation of establishing adhesions at the site of tapping, using a large trocar, washing out the cavity and draining it.

IV. In large movable cysts with partially solid contents—i.e. containing daughter-cysts, and with but few adhesions—the operation of abdominal section and removal of the cyst or cysts entire.

T. Naghten FitzGerald.

HYDRARTHROSIS.—An effusion of fluid into the synovial cavity of a joint, unattended by symptoms of inflammation.

This condition, met with chiefly in the knee, may either result from a previous subacute inflammation, or may from the first be of a passive and indolent character. Usually at the commencement of even the most chronic cases there is slight increase of the temperature of the affected joint; but there is no pyrexia, and pain is absent or very slight. The joint is distended to a degree which makes manifest the reflexions of the synovial membrane; fluctuation can be felt across its cavity, the ligaments are stretched, and there is a feeling of weakness and instability. The contained fluid is of pale yellow colour, slightly turbid, and highly albuminous.

This affection is sometimes the commencement of the joint-disease associated with locomotor ataxy. *See* Charcot's Disease.

The *treatment* will consist of immobilisation, counter-irritation, and pressure.

The limb being placed upon a splint, the joint should be repeatedly blistered. When the fluid has been thus considerably reduced, a layer of cotton-wool should be placed over the joint and an elastic bandage applied; or the joint may be strapped over lint spread with camphorated mercurial ointment.

If, in spite of such measures, the effusion persists, the joint is to be emptied by aspiration, with antiseptic precautions, after which elastic pressure is to be maintained; and, should this fail, the aspiration must be repeated, with the addition of an intra-articular injection. The fluid injected must be aseptic and mildly stimulant. A 1 per cent. watery solution of carbolic acid, or a mixture of tincture of iodine and water (1 in 10), are appropriate injections, though stronger solutions than these are sometimes necessary. The injected fluid having been brought into contact with every part of the synovial cavity, is then withdrawn, the puncture closed, and the joint covered with a layer of cotton-wool and a bandage. The injection is usually followed by a slight inflammation and swelling of the joint, which subsides without treatment, and leaves the synovial membrane with less tendency to excessive secretion.

This treatment is, however, not unattended with danger, from the too great acuteness of the resulting inflammation, and should only be used in otherwise healthy persons. When the use of the joint is resumed support must be given by an elastic bandage.

J. Warrington Haward.

HYDROCELE.—It will be convenient to consider the varieties of hydrocele in accordance with the following classification, and in the following order :—

(1) Acute vaginal hydrocele; (2) Chronic vaginal hydrocele; (3) Congenital hydrocele; (4) Infantile hydrocele; (5) Encysted hydrocele of the testis; (6) Encysted hydrocele of the cord; (7) Diffuse hydrocele of the cord; (8) Inguinal hydrocele; (9) Hydrocele of a hernial sac.

1. Acute Vaginal Hydrocele or acute inflammation of the tunica vaginalis with effusion.

Causes.—The most frequent cause is acute epididymitis, for, owing to the absence of any tough fibrous or other membrane between the epididymis and the subserous tissue of the tunica vaginalis, inflammation very readily and frequently extends from the one to the other. It may be excited by direct injury to the part by blows, squeezes, &c.; by injection of irritating solutions thrown into the serous sac for the cure of a chronic hydrocele; and the use of a dirty trocar and canula in tapping a hydrocele may be followed by acute hydrocele.

Pathology.—The pathological changes resemble those in acute inflammation of other serous membranes. There is considerable engorgement of the veins in the subserous connective tissue, with œdema, which may extend to the superficial structures of the scrotum. The surface epithelium proliferates rapidly, and parts of it become shed in the form of shreddy flakes, and lymph may coat its surface in flakes or in soft, yellow, butter-like masses. The fluid effused into the sac is turbid and very richly albuminous; it is generally in small quantity only. The effusion may become chronic, or, on the other hand, when the inflammation is very acute and not speedily allayed, it may become purulent. Slight or extensive adhesions between the two serous surfaces may be left behind.

Symptoms and Diagnosis.—As most often met with, it causes a moderate, elastic, and fluctuating swelling of the scrotum in front of the inflamed epididymis. The skin over this swelling is reddened and often œdematous. When occurring primarily, there is a moderate globular enlargement of the scrotum, with redness and œdema of the skin and deep fluctuation; the pain and tenderness are not so severe as in inflammation of the testicle, and the cord is not thickened. As, however, the inflammation tends to spread to and affect the epididymis, these distinctions are not often to be observed. The diagnosis rests, therefore, upon detecting an acute inflammatory and fluctuating swelling over the front of the testicle. Should the superficial œdema increase, the swelling 'point,' and the patient experience a rigor or rigors with increased fever, the diagnosis of suppuration in the tunica vaginalis, or pyocele, may be made.

Treatment.—When it is secondary to epididymitis, the treatment of the latter meets the indications. *See* Testis, Diseases of the. When primary, the patient should be confined to bed, with the scrotum raised upon a cushion between the thighs, or a broad strip of plaster stretched across between the thighs; and hot belladonna fomentations should be applied. The bowels, if necessary, are to be cleared by a purge, and the diet should be light and mainly fluid. Tapping should not be performed. Should suppuration occur, the surgeon must at once lay the tunica vaginalis freely open and wash out the cavity with some antiseptic lotion, allowing the wound to heal by granulation.

2. Chronic Vaginal Hydrocele.—*Causes.*—Chronic hydrocele is sometimes secondary to inflammatory and other enlargements of the testicle, such a condition being known as hydro-sarcocele. If we exclude these cases, little is known of the causes of this very common affection. Its frequency in infancy and about middle life suggests that it may be connected with the structural and functional changes occurring at these periods; and when, as sometimes happens, it is seen in several members of one family, an hereditary influence may be inferred. In some cases repeated strains and local injuries appear to occasion the disease, and it has been alleged that hydrocele is especially common in those who are, or have been, the subjects of diseases of the urethra or prostate. In rare instances small loose bodies are found in the tunica vaginalis and are believed to be the cause of hydrocele. The great frequency of the disease in tropical climates supports the view of a malarial origin, and its common association with elephantiasis scroti, when this disease is met with, suggests some etiological factor common to the two. An enfeebled circulation, chronic visceral disease, the dependent position of the scrotum, and relaxation of the dartos, are other alleged causes of hydrocele.

Pathology.—Two views are held as to the nature of chronic hydrocele; by some it is regarded as a 'dropsy,' and by others as an 'inflammatory effusion.' In the author's opinion the evidence appears to support the latter view. The disease occurs about equally on the two sides, and is as often double as single. When double, the effusion is generally later and also less in amount on one side than the other. In children, hydrocele is most common on the right side. The common case is for the tunica vaginalis to be distended into a pyriform or ovoid sac, across which slender adhesions may occasionally be found stretching. But the cavity may be sacculated, and of this three varieties have been noticed. Broad bands of adhesions may divide the cavity into closed or intercommunicating cavities. A pouch is sometimes found extending between the epididymis and the body of the testicle, opening into the general sac on the outer side; this may be regarded as a deepening of the normal digital fossa. The rarest form is that in which a hernial protrusion is found extending outwards into the dartos, this variety being caused by a distension of one of the very delicate, finger-like processes which normally project from the parietal layer of the tunica vaginalis. The serous membrane may remain unaltered in structure even in large and old hydroceles, but more generally its deeper layers are thickened by the addition of newly-formed fibrous tissue, and in some long-standing cases this tissue may attain a cartilaginous consistence, or may become calcified, the lime-salts being deposited in plates or thicker masses. This thickening of the membrane is found to extend over the epididymis, but to a much smaller extent, if at all, over the body of the testicle.

The fluid varies in quantity up to several pints, as much as six quarts having been withdrawn from the historian Gibbon. In adults the average quantity is from six to sixteen ounces. The fluid is of a bright straw colour, sometimes deeper in tint, at others having a greenish hue, and from the admixture of blood (hydro-hæmatocele) it may be rendered opaque and dark. Its specific gravity is about 1024; in reaction it is slightly alkaline. It contains a large amount of fibrinogen, but no fibrin-ferment, and does not coagulate spontaneously unless blood or some other source of the ferment is added to it. A small amount of fatty matter is normally present, and also cholesterine in larger quantity than in any dropsical effusion. Succinic acid is also stated to be present. Fine flakes of lymph, cholesterine crystals, and epithelial cells or shreds may be found under the microscope; and very rarely, larger solid bodies or thick-walled cysts may be found loose in the vaginal sac, these probably being detached hydatids of Morgagni. The fluid may be altered in appearance by the presence of an unusual quantity of cholesterine in the form of sparkling crystals, and, in some cases, the tunica vaginalis has been found filled with a soft solid mass of this substance.

A much rarer condition is the admixture of finely-divided fat, in such quantity as to impart a milky look to the fluid, which retains its turbidity on standing. Where there is a combination of encysted hydrocele of the testis with vaginal hydrocele, the former may rupture into the latter, and, in that case, the fluid may have an opalescent or milky appearance from the admixture of semen; on standing, an opalescent sediment falls, leaving the supernatant fluid clear. The testicle is usually found at the lower and back part of the sac, but when that organ is inverted, it lies at the lower and anterior part; the testicle may be fixed in some unusual position by adhesions. When the quantity of fluid is large the organ is flattened out, and, in old cases, may scarcely project at all into the cavity. As a rule its function is not interfered with, but occasionally the organ is found anæmic and atrophied, and then it probably fails to secrete spermatozoa. The constituents of the spermatic cord are sometimes separated and spread out by the pressure of the fluid in the vaginal sac. The tissues of the scrotum over a hydrocele in time become more or less matted together, and the muscular bundles of the cremaster are hypertrophied, with hyperplasia of the connective tissue making up the cremasteric fascia. In very large tumours of long standing this muscle is apt to atrophy.

Symptoms and Diagnosis.—The main symptom of chronic vaginal hydrocele is the scrotal swelling which it occasions; this leads to a sense of weight in the groin which the patient endeavours to relieve by wearing some form of suspensory bandage; when of large size the swelling impedes free motion, and forms an unsightly prominence difficult or impossible to conceal. A more serious effect is that it renders the part liable to injury, and, owing to the distension of the vaginal sac, the force of contusions is transmitted directly to the testicle, and in this way hæmatocele may be superadded. As the scrotum becomes distended, the skin of the penis is gradually drawn over the swelling, and the penis proper is lost in the scrotum, the glans being at the bottom of an umbilicus-like depression. This is generally a source of much annoyance to the patient, and the trickling of urine over the scrotum may excoriate the part. It is often noticed that the swelling is larger at night than in the morning. When the effusion accumulates with unusual rapidity, or the sac is very tense, or when the part has been contused, or the testicle is inflamed, or blood has been effused into the vaginal sac, the patient may experience acute pain. All the symptoms of hydrocele are much exaggerated when the affection is double.

The tumour, which grows from below, is limited to the scrotum, and the cord can be felt quite free above it. Usually pyriform in shape, it may be ovoid, globular, or may present a circular constriction about its centre. Its surface is smooth, and the tension of the swelling is uniform, but variable in degree in different cases. Fluctuation is to be detected quite across the tumour, which is also translucent. There is no impulse on coughing, and the swelling is entirely irreducible into the belly; the skin over it is not adherent to the deeper parts. The position of the testicle should always be made out; it can be determined by noticing an increased resistance to pressure at one part, by the patient experiencing the peculiar 'testicular pain' when the organ is manipulated, and by observing that at this part too the tumour is opaque to transmitted light. Where all these signs are present the diagnosis is quite easy and certain, but when the sac or its coverings are greatly thickened and opaque, or the contents are opaque or reduced to a solid mass of cholesterine, or a hernia or some other swelling is superadded, the diagnosis may be very difficult or even impossible without an exploratory operation.

From hernia, hydrocele is to be distinguished by its growth from below instead of from above, by its irreducibility, fluctuation, and translucency, and also by the fact that the cord and the inguinal canal are free. When there is a hernia with hydrocele, the distensile impulse on coughing may be transmitted from the hernia to the hydrocele; after reduction of the hernia the hydrocele-swelling will present all its usual characters. Should the hernia be irreducible, the diagnosis becomes more difficult, but the history will probably throw light upon the case; the difference in outline, tension, and consistence of the upper and lower parts of the swelling, the absence of fluctuation and translucency in the upper part, which may be tympanitic on percussion or present the lobulated feel of omentum, and lastly, the extension of the swelling up to but not beyond the internal abdominal ring, are the signs by which this condition is to be recognised. (For hydrocele extending up to or beyond the internal abdominal ring, see *Infantile Hydrocele.*) The chronic character of the swelling, its uniformity, fluctuation, and translucency, together with the detection of the testicle at one part of it, will distinguish hydrocele from malignant tumours of the testicle. From hæmatocele the diagnosis of hydrocele is made by the difference in the mode of origin of the tumours, and usually by the translucency of hydrocele. When a doubt exists, an exploratory puncture will usually clear up the case, but a better plan is to make an incision with antiseptic precautions carefully down into the tumour; this affords more information, and also is the best means of curing the cases which present this difficulty in diagnosis.

Fluctuation and translucency are thus seen to be two very important signs of hydrocele. Fluctuation in scrotal tumours is best detected by grasping the mass with the fingers and thumb of each hand, and then, when compression is made with one hand, the part of the tumour grasped by the other will be felt to become more tense. To test for translucency it is necessary to have a good light, to grasp the tumour properly, and to carefully shut off the rays of light passing over the scrotum. The light should be held on the outer side; the swelling should be seized from behind and made tense in front, and neither the surgeon's fingers nor the patient's penis should be allowed to intercept the rays of light; a stethoscope or some larger tube may be used to look at the part, or the external rays of light may be shut off by the surgeon's other hand. When translucent, a more or less intense reddish glare is seen, the testicle appearing as a dark shadow.

Treatment.—In infants spontaneous cure is not very rare, and the surgeon may fairly wait for a time to see whether it will occur; it is generally thought that the use of an absorbent lotion containing acetate of ammonia and iodide of potassium, or painting the scrotum with diluted tincture of iodine—1 to 3 of spirit—may aid this process. Should it not occur, acupuncture is generally sufficient to bring about a cure, and in the rare cases which resist this measure, injection of the sac must be resorted to. In adults spontaneous cure does, very rarely, take place as a result of injury, but the surgeon should never expect it, and if the swelling is of such a size as to cause annoyance to the patient or is increasing, he must adopt some treatment. Tapping the hydrocele should be first performed, which affords immediate relief; in some few cases it results in cure, but in the great majority it is followed by more or less rapid re-secretion of the fluid. When the fluid accumulates very slowly and causes only trifling inconvenience, or when the patient is aged or the subject of serious visceral disease, the repetition of this trifling operation is the proper treatment. But in other cases when tapping fails to cure, and the inconvenience caused by the affection is marked, and the state of the patient does not afford any sufficient contraindication, a radical cure must be attempted. Many methods have been suggested, but two only—injection of a stimulating fluid and incision of the serous sac—are now practised; the use of setons and caustics has been rightly abandoned. Of the two methods, that by injection is more generally employed; it has the advantage of simplicity and, when carefully done, of safety; but it is liable to failure or to be followed by recurrence of the disease. Incision requires to be done with careful antiseptic precautions; but it is then a safe operation and certain in its results. It should undoubtedly be resorted to when injection has failed, when the sac is considerably thickened or contains loose bodies, when the hydrocele is compound or sacculated or combined with encysted hydrocele, when there is doubt as to the diagnosis, and in the case of aged persons in whom the operation of injection presents special danger.

(1) *Acupuncture.*—The object of this procedure is to allow the serous fluid to leak out into the cellular tissue of the scrotum, whence it is very readily absorbed. An ordinary sewing needle may be employed, but a harelip pin is the best instrument. The swelling being made tense, the needle is thrust obliquely into the sac, and then, without withdrawing it through the skin, the needle is made to puncture the tunica vaginalis in three or four places—not by its point but by the edge of its lance-shaped end. A little fluid generally trickles from the skin-puncture.

(2) *Tapping a Hydrocele.*—For this purpose the common hydrocele trocar and canula is much the best instrument. The surgeon should be careful to have the trocar sharp, the canula well-fitting, and the whole scrupulously clean. The patient may stand with his back against a wall; but should he be nervous, very old, weakly, and liable to faint, or when the hydrocele is very large, he should lie on his side at the edge of a couch. Care must be taken to enter the serous sac without pushing it before the instrument, and not to allow the sac to slip over the end of the canula when it retracts as the fluid escapes; and the surgeon must guard against wounding the testicle, cord, or one of the scrotal veins. Having accurately determined the position of the testicle, a spot is chosen on the opposite side of the scrotum, towards the lower part of the swelling and where the skin is free from visible vessels. With the left hand the scrotum is grasped so as to make the skin and the swelling as tense as possible at this part, and then with the right hand the well-oiled trocar is thrust into the sac; as soon as the instrument is free in the cavity, its point should be directed upwards parallel with the cord, and the canula alone should be pushed in for its whole length. Some surgeons prefer to insert the instrument by steady continuous pressure, while others resort to a quick thrust; each method has its advantages and defects.

The slower method is said to be less painful, and free from risk of injuring the testicle or cord, but the danger of displacing the tunica vaginalis is greater, and therefore this plan should only be adopted when the sac is tense. The more rapid method is free from this danger, but exposes the patient to some risk of puncture of the testicle or of a spermatic vein, unless skilfully performed. The best safeguard is to hold the instrument with the forefinger placed half an inch from its extremity, so that it cannot be plunged in too deeply, and if at the same time the thumb-nail is held behind the broad flange of the canula, it can slip this on over the end of the trocar as soon as the sac is pierced, and while the whole hand is depressed, so as to direct the point of the instrument up along the cord. All the fluid should be removed, the last few drops being gently pressed out; the testicle will be found tender in recent cases. On withdrawing the canula a dossil of iodoform wool should be placed over the skin-puncture, and the scrotum supported in a suspender; the patient should be directed to keep quiet in his room for the remainder of the day.

(3) *Injection of a Hydrocele.*—A favourable time should be chosen when the patient is in good health, and the tumour contains about six ounces of fluid, and the testicle is not tender. It should then be tapped in the usual way, care being taken to push the whole length of the canula into the tunica vaginalis. By means of a well-fitting syringe a stimulating fluid is thrown into the vaginal sac, and the canula is then carefully withdrawn so as not to allow any of this fluid to escape into the superficial tissues of the scrotum. The best form of syringe is one with a long metal nozzle which fits the canula, and when passed in to its full length just projects beyond the end of the canula; by using this syringe the surgeon may be sure of injecting all the fluid into the tunica vaginalis. Many fluids have been used. The most popular, and one which rarely fails, is a solution of 40 grs. of iodine and 30 grs. of iodide of potassium in an ounce of water, of which from 1 to 2 drachms are to be injected. In children the fluid should be diluted one half. Some surgeons prefer the tincture of iodine, B.P., or that diluted with an equal bulk of water; after injection and thorough manipulation of the part, some operators prefer to allow some of the fluid to escape before withdrawing the canula. The operation may cause little or no pain, or be attended with severe pain and great tendency to syncope. Similar differences are seen in the subsequent course of the cases. Generally the injection is quickly followed by a moderate effusion of fluid, with slight redness and tenderness of the scrotum and trifling pyrexia; these symptoms gradually subside, and the fluid is absorbed. But in some cases the inflammation assumes a severer grade, and it is necessary to keep the patient at absolute rest, on spoon diet, and with hot belladonna fomentations to allay the local inflammation. In yet other cases the injection fails to excite sufficient inflammation, and then the surgeon has to manipulate the part freely and let the patient walk about, to try by these means to supplement the irritant action of the iodine. If the fluid at first poured out is not afterwards absorbed, the scrotum should be strapped. The injection sets up a subacute or acute hydrocele, and when the products are absorbed the cavity of the tunica vaginalis, as a rule, is not obliterated, although limited adhesions may form. Iodine may fail to excite sufficient inflammation, or the fluid poured out may not be reabsorbed, and in some cases the sac may be too dense to collapse. On the other hand, if used too strong, it may set up suppuration.

Recently, injection of pure carbolic acid, with just sufficient water added to liquefy the crystals, has been practised. From ♏v–x. is the amount required. The operation is almost if not entirely devoid of pain, and the subsequent inflammation appears to be more uniform in degree than when iodine is used. The author has used carbolic acid in many cases, and with some success; it is certainly less painful than iodine, and he has found it quite unnecessary to confine his patients to bed afterwards; often they are able to go about their work as usual. The acid should always be injected with the long-nozzled syringe. Port wine, chloride of zinc solution, and many other fluids have been recommended and used, but they none of them are equal in value to iodine or carbolic acid. Latterly, finely-powdered iodoform has been introduced into the cavity of the tunica vaginalis, and this practice is highly spoken of; the writer has had no experience of it.

(4) *Incision of a Hydrocele.*—For this the scrotum and pubes should be shaved and thoroughly cleansed, and, using all the usual antiseptic precautions, the surgeon should make a vertical incision two inches long over the front of the swelling. After arresting all hæmorrhage from superficial vessels, the tunica vaginalis is to be opened

for the same length and the fluid allowed to escape. The cut edge of the serous sac is to be united to the skin by one or two chromic catgut stitches on each side, and a drainage-tube is to be passed in to the bottom of the cavity. Outside, the usual carbolic gauze dressing is to be applied. The dressing will need to be changed every third or fourth day, and the tube is to be shortened from time to time, and removed altogether as soon as the discharge is reduced to a few drops. The patient may generally be allowed to get up at the end of the second week. The operation is followed by very slight pyrexia, and slight orchitis for the first two or three days. As the serous cavity is obliterated by this treatment, the cure of the hydrocele is certain and permanent.

3. CONGENITAL HYDROCELE.—*Etiology.* The cause of this variety of hydrocele is a congenital malformation; the processus vaginalis is not obliterated, the tunica vaginalis being therefore continuous with the general peritoneal cavity. Nothing definite is known of the cause of this malformation; it is said to be more common in weakly children and in those born prematurely.

Pathology. — The communication between the tunica vaginalis and the peritoneal cavity may be very free, or it may be valvular or reduced in size until it only admits fluid to flow along it drop by drop; and this constriction may be at one point only—either at the internal abdominal ring or just above the testicle—or involve some length of the serous tube. Congenital inguinal hernia is often associated with it. It may be unilateral or bilateral.

Symptoms and Diagnosis.—The swelling, which is most often noticed in early infancy, has the general characters of hydrocele, being fluctuating, translucent, and surrounding the testicle. In addition, it exhibits a distinct expansile impulse on coughing or crying, and is wholly reducible into the belly without occasioning any intra-abdominal tumour. This reduction is never accompanied with a 'slip' or 'gurgle'; when the communication is free, it is rapid, but when narrow, it is very slow and easily overlooked unless great care be taken and the attempt to reduce it be continued for some few minutes; and this precaution must be observed in every case of hydrocele in infants and young children. When the serous tube is irregularly constricted for some distance, the flow of fluid along it may be attended with a fine fremitus. Should the upper part of the swelling be opaque, or tympanitic on percussion, or yield a gurgle on manipulation, or recede with a sudden slip during taxis, a congenital inguinal hernia is present; a combination of two or more of these signs will render this diagnosis more obvious. Whenever the swelling can be seen or felt to extend along the inguinal canal, or is found to yield a very marked impulse on coughing, hernia is to be suspected.

Treatment.—A well-fitting truss should be applied, to prevent the descent of a hernia, and to induce obliteration of the vaginal process of peritoneum. When this is obtained, the remaining hydrocele can be treated like an ordinary chronic hydrocele. Should obliteration not result—a rare event—and further treatment be necessary, the sac may be injected with the iodine solution, or, better, incised and drained antiseptically. When hernia is combined with the hydrocele, the treatment must be directed to secure the radical cure of this condition, by ligature of the neck of the sac and suture of the inguinal ring if it be dilated.

4. INFANTILE HYDROCELE.—Under this name are known cases of vaginal hydrocele which involve more or less of the process of peritoneum in front of the cord, but are shut off from the peritoneal cavity by obliteration of the tube at or near the internal abdominal ring. The majority of cases of hydrocele in infants are of this nature, and it is rare to find this affection in adults. In men, however, the upper part of the sac may be distended and even form a tumour of large size behind the belly-wall but outside the peritoneal cavity.

Symptoms and Diagnosis.—If the swelling extend up to, but not through, the external abdominal ring, its shape and extent are the only features peculiar to it. Should the sac reach up along the cord in the inguinal canal, there will be an expansile impulse on coughing, but the tumour will be entirely irreducible. In the rare cases in which a sac or pouch is formed within the belly, this internal tumour will be felt, and fluctuation will be detected between it and the scrotal swelling, the one becoming more tense as the other yields under pressure. This simulates reducibility of the scrotal swelling, but the detection of the internal tumour and its increased tension as the scrotum is emptied, will distinguish the case from congenital hydrocele: in such cases there is, of course, a well-marked impulse on coughing.

Treatment.—The application of absorbent lotions or of weak iodine paint to the scrotum should first be tried, and if these fail, acupuncture will usually succeed.

Should a case resist this means, injection with iodine or incision should be practised. Care in the diet and general hygiene of the child may aid in the cure, and, where indicated, tonics should be given.

5. ENCYSTED HYDROCELE OF THE TESTICLE.—*Pathology.*—Three varieties of hydrocele in connection with the testicle, in which the fluid is not contained in the tunica vaginalis are met with. The most important are cysts in connection with the epididymis — generally the upper part—globular or lobed in outline, and rarely attaining a large size. They consist of a delicate fibrous membrane, lined with tesselated epithelium. The fluid is transparent and colourless, containing a small trace of albumen, chloride of sodium, and alkaline carbonates which give effervescence on the addition of acetic acid. In a certain number of cases the fluid is opalescent or milky in colour, and on standing yields an opaque sediment, consisting of spermatozoa, which may be found moving actively, motionless, or broken up. As the cyst enlarges the vasa efferentia are spread out over it, and it is by the rupture of one or more of these tubes into the cyst—sometimes from injury—that the semen finds entrance to the hydrocele. Such cysts are usually single, they may be multilocular, but are very rarely more than two or three in number. A very unusual condition is for such a cyst to extend up along the cord even to the groin. These cysts have been supposed to arise from dilatations or ruptures of the vasa efferentia, but it is more probable that they are dilatations of the remnants of fœtal structures, particularly of the organ of Giraldès, and the duct of Müller, possibly also of the vas aberrans of Haller. The second and very rare variety is a cyst beneath the tunica albuginea testis, pressing the seminal tubes aside. This condition probably ensues upon parenchymatous hæmatocele. *See* HÆMATOCELE. The third variety consists in the development of small subserous cysts, the size of peas or currants, in connection with the head of the epididymis; they are common after forty years of age, very rare before that, never contain spermatozoa, and are of no clinical importance.

Symptoms and Diagnosis.—Only the first of the three varieties named above will be considered. The cyst forms a tense globular or lobed tumour attached to the epididymis, and generally situated above and behind the testicle. This tumour is translucent, fluctuating, very movable in the scrotum, without impulse on coughing, and quite irreducible by pressure. The growth is slow, and the tumour is usually painless, and may remain stationary. When of small size the fluid is clear; when larger, it is very frequently mixed with semen. An enlargement occurring suddenly, or following upon an injury, may be assumed to indicate a rupture into the cyst of a seminal tubule. The affection is most common in boys and young adults. Encysted hydrocele may be associated with vaginal hydrocele, and the cyst may rupture into the tunica vaginalis. The diagnosis of hydrocele will rest upon the fluctuation in and translucency of the tumour; the variety of hydrocele will be recognised from the tumour being fixed to but not surrounding or obscuring the testicle, by the small size and globular shape of the cyst, together with its slow growth and the character of the fluid.

Treatment.—When the cyst attains any size or gives rise to annoyance, it should be tapped, the trocar being introduced from the outer side. Should this fail to cure, the surgeon may attempt the radical cure—either by injection of iodine, by a seton of threads soaked in tincture of iodine, or by antiseptic incision. Injection often fails. Incision is readily performed and very certain in its results, and is therefore the best treatment for the cases in which tapping is insufficient.

6. ENCYSTED HYDROCELE OF THE SPERMATIC CORD.—This is a circumscribed collection of serous fluid in connection with the cord. The cyst is generally developed by distension of an unobliterated part of the vaginal process of peritoneum. Some cysts may be of new formation or dilatations of the organ of Giraldès.

Symptoms and Diagnosis.—The affection is relatively frequent in boys and young men. The tumour is of small or moderate size, ovoid in shape, and attached to the cord; it fluctuates, is translucent and irreducible, but very movable up and down with the cord; its outline is always well defined. If situated in the inguinal canal it is impossible to test for translucency, and the swelling will expand on coughing. By making traction upon the testicle the mobility of the tumour is greatly lessened.

Treatment.—This is the same as for chronic vaginal hydrocele. In the first place absorbents may be tried, and, should they fail, acupuncture, tapping with a trocar, injection with iodine and antiseptic incision may be relied upon in order of merit and safety. Before applying any means of radical cure, great care must be taken to determine that the sac does not communicate with the peritoneal cavity by a narrow channel; such a condition has been called the *water-bottle hydrocele.*

7. Diffuse Hydrocele of the Cord, or œdema of the areolar tissue of the spermatic cord, is a rare condition, the causes of which are not understood. The writer has seen it follow wearing an ill-fitting truss. The spermatic cord is uniformly enlarged, the swelling being elastic, yielding to pressure, with impulse on coughing, but neither fluctuating nor translucent. The tumour may attain a very large size. It is to be distinguished from a hernia by the less clear definition of the swelling, its dulness on percussion, irreducibility into the belly, absence of gurgling, the less clear impulse on coughing, and its smooth contour. Where there is doubt in the diagnosis, a careful incision should be made into the part.

Treatment. — Acupuncture, or tapping with a trocar, may first be tried, and if the fluid reaccumulate, an incision with antiseptic precautions is the best means of obtaining a radical cure.

8. Inguinal Hydrocele. — This is a very rare condition, caused by the accumulation of fluid in a closed serous sac around a testicle retained in the inguinal canal. The cause of the effusion is the injury to which the organ is exposed in its abnormal position. Part of the swelling may escape through the external ring and extend transversely along the groin in the superficial structures.

Symptoms and Diagnosis.—There is a fluctuating, translucent, irreducible tumour in the groin, and the scrotum on the same side is found undeveloped and not containing a testicle. In the recorded cases there is stated to have been no impulse on coughing.

The *treatment* consists in a free incision into the tumour, the removal of the testicle and the careful dissection out of the serous sac. By this means the hydrocele is radically cured, and the patient is freed from the annoyance and risk attending imperfect descent of the testicle.

9. Hydrocele of a Hernial Sac.—By this is meant an effusion of serous fluid into the sac of a hernia, which has become shut off from the peritoneal cavity by plugging of its neck with omentum, or its obliteration as the result of wearing a truss. The disease is more common, and attains greater magnitude, in inguinal than in femoral hernia. The fluid resembles in character that of chronic vaginal hydrocele.

The *symptoms* will be those of a fluctuating, translucent, irreducible swelling, occurring at the site of an old hernia for which, usually, a truss has long been worn. If scrotal, the swelling will reach up to or even into the inguinal canal, and in the latter case will have a faint impulse on coughing. The testicle will not be lost in the swelling as in vaginal hydrocele, nor attached to the cyst as in encysted hydrocele.

The *treatment* consists first in tapping the tumour, and, if this fail to give permanent relief, an incision with antiseptic precautions will be the best means of obliterating the sac. A. Pearce Gould.

HYDROCELE OF THE NECK is the name given to a peculiar form of cystic growth which is generally found to lie in the line of the sterno-mastoid on one or sometimes on both sides, and which is, in the majority of cases, of congenital origin, and therefore noticed at or soon after birth; but, in rare instances, develops much later and even at an advanced age, one having been described in a patient over seventy. The congenital form is identical with the condition which goes by the name of 'cystic hygroma,' and which occurs also in the axilla, on the back, and around the kidney; but when developing in later life, the disease bears a resemblance to the single blood-cysts which are found in other parts of the body.

The growth is composed of cysts which push forward the healthy skin covering them, and render it tense, so that their conformation, lobulated form, and even their contents, may be seen through it. They may present at any part of the neck between the mastoid process and the clavicle, but the favourite situation is below the jaw, or springing from the posterior triangle of the neck. In size they show great variety, sometimes being quite small, at others attaining enormous proportions. Their progress is remarkably capricious, at one time remaining at a standstill, and at others increasing with great rapidity, and this even after many years of quiescence. The whole, or a portion, will sometimes diminish in size, or altogether disappear. Nor are all the parts found to increase in the same ratio, and thus they will occasionally cause symptoms of pressure without any evident increase in bulk. It is to their pressure-effects that their fatality in early life is to be ascribed, since they are often continued down into the thorax, surrounding the trachea, and extending into the mediastina.

Cause and Pathology.—On dissection, the tumour appears to be an aggregation of cysts, often in great numbers, the components of which are nothing but an exaggeration or hypertrophy of the cellular tissue of the part. Although presenting superficially, they generally originate beneath the deep cervical fascia, and protrude in all the parts with which that structure is connected. Thus, they sometimes are situated beneath the tongue, and cause one of the forms of ranula, or they may pass across the median line and present upon both sides of the neck, and, as already stated, may extend into the thorax or axilla. The fluid contents are enclosed in a wall of areolar tissue, smooth, glistening, and finely fibrous, though differing greatly as to consistence, even in various parts of the same tumour, so that the larger cysts will be found enclosed by a thin covering, and the smaller by a dense wall of similar structure. The size of the cysts varies from that of a pea to that of an orange, and their contents are equally prone to vary as to colour and consistence. The fluid in one will be found to be clear and watery, while that of its adjoining neighbour may be composed of blood-stained serum, in which may float white, flocculent particles of lymph-coagulum; and whilst one cyst may give the sensation of a bag of fluid, the adjoining ones may be so tense as to appear solid. Occasionally fleshy masses are seen in the growth, but, as a rule, the only solid elements consist of hypertrophied connective tissue. Lymphatic glands are not affected, but are often surrounded and enclosed, as are also the vessels and nerves. The size to which, in some cases, these tumours have attained is enormous, and they are prone to inflame under very slight provocations, as from blows, &c., or will often do so spontaneously.

The *symptoms* and *diagnosis* of this affection are so obvious, that little need be said as to any distinction which must be drawn between it and other tumours which may occur in this region. Large venous nævi are the only swellings with which it is likely to be confounded; but in these the dilated walls of the numerous veins show through the thin coverings of the skin, and, as opposed to what occurs in a cystic growth, their bulk can be diminished by firm pressure, and their size is immediately re-established when it is relaxed. To fatty tumours these growths may bear some resemblance; but whilst the one is seldom, the other is nearly always congenital, and can, when rendered tense, be made in some part translucent with a strong light.

Treatment.—When it seems fairly probable that the tumour is only a single cyst, it is justifiable to try the effect of tapping, with or without the subsequent injection of tincture of iodine, or Morton's solution, composed of iodine, iodide of potassium, and glycerine. After injection, the trocar should remain for a few seconds, to allow any remaining fluid to drain off. But when, as is most usually the case, there are numerous cysts, by far the most successful method of treatment is to pass a seton of fine silk or catgut through a portion of the tumour, and to leave it until some sign of inflammation is evident, but before suppuration has taken place, when it should be withdrawn.

Inflammation of this hypertrophied tissue is very easily excited, and it must be allowed to subside before the introduction of a fresh seton into any other portion of the growth. Should suppuration occur from any cause, an incision must be made and a drainage-tube inserted, the cavity being freely washed out with some antiseptic solution. It will usually be found that when a portion of the tumour has begun to contract, the rest will follow suit, and therefore due time must be given for this to occur. If a large portion appear to be solid, and yet the increase in size of the whole tumour be evident, the question of excision may be entertained; but this is seldom to be advised, on account of the deep connections of these cysts, and the tendency to resume growth shown by any portion which may be left. JOHN H. MORGAN.

HYDRONEPHROSIS, or the distension of the pelvis of the kidney with urine, is a comparatively common affection, especially when unilateral; double hydronephrosis is, on the other hand, răre.

The *causes* of this condition are many. The commonest is impaction of a stone in the top of the ureter; next to this the closure of the latter by some inflammatory change; then tubercular deposits blocking the ureter, or the contraction of a tubercular ulcer. Again, growths of the kidney of various kinds may cause retention and hydronephrosis, the commonest being papillomata. Besides these, pressure from without may initiate retention of urine in the pelvis of the kidney, and a consequent obliquity of the course of the ureter in the wall of the distending sac may perpetuate the condition. Among the sources of external pressure on the ureter may be mentioned the gravid uterus, perimetritis, tumours of the pelvis, and, finally, the presence of an aberrant renal artery. Finally, there is in some kidneys an almost valvular arrangement of the mucous membrane at the point of origin of the ureter, which predisposes to the formation of this condition and maintains it when once produced. In no recorded case, so far as the writer can ascertain, has hydronephrosis been proved to have resulted from injury to the ureter itself from without, with cicatricial closure of its lumen. In a few cases, however, the history and symptoms at first appeared to point to such a cause (vide *Lancet*, January 17, 1885); but in all the accumulation was shown, later on, to be retroperitoneal effusion of urine from a torn ureter, and not from distension of the pelvis of the kidney. This form of lumbar 'urinary abscess' might perhaps be called 'spurious hydronephrosis,' resembling as it does so closely the true form, and under this head it will be considered lower down.

The *objective symptoms* of hydronephrosis are usually the same, however the condition be produced. We find a large fluid tumour in either flank, having in all cases the same relations. It lies below the liver, and behind and outside the colon. It begins to grow above, and enlarges downwards and inwards towards the umbilicus, and may even cross the middle line of the body. With such a tumour there is dulness over the flank behind, between the ribs and iliac crest, and extending forwards until the colon note is reached at a varying point. This dulness reaches vertically from the liver to the iliac fossa as a rule, and over the same area a distinct wave can usually be felt on percussion with the fingers. In doubtful cases, the exact relation of the colon to the swelling can be ascertained by alternately filling and emptying the bowel, with fluid or air pumped in through the anus. The size of the tumour varies greatly, but as its presence is not usually accompanied by much suffering in the earlier stages, it is first met with by the surgeon, as a rule, when it has become very large, and contains many pints, or even gallons, of fluid.

The *subjective symptoms* are few, and only noticed definitely when the tumour has reached a large size. Slight pain, of a dull, aching character, may be complained of, but is usually absent. Digestive derangements, due to pressure of the growth upon the intestines and consequent constipation, may also be observed. The tumour may also produce a certain amount of dyspnœa by interfering with the descent of the diaphragm. There is one symptom which, if present, is characteristic of hydronephrosis. This is the sudden passage of very large quantities of urine, with subsidence of the lumbar swelling, and the rapid reappearance of the latter after the flux has ceased. This indicates the sudden removal of the obstruction for a time, and the escape of the contents of the hydronephrosis into the bladder. Exploratory puncture, with a fine aspirator-needle, will also generally settle the nature of the tumour. This should always be done from behind, midway between the iliac crest and last rib, and about two and a half inches from the spinous processes, at which point no structure of importance can, with ordinary care, be wounded. If a clear fluid is here drawn off from a tumour, having the relations detailed above, it is almost certain to be a hydronephrosis.

The *diagnosis*, thus made, is not weakened by the discovery that the fluid drawn off contains only a trace of urea and is rich in albumen, for it is now well known that urine secreted against a steady resistance, such as the elasticity of the sac receiving it in this case, is always deficient in urea in proportion to the resistance to be overcome; it is also noticed to contain, as a rule, much albumen and mucin. This is true even of a perfectly healthy kidney, whose ureter has only recently become blocked. The amount of urine secreted by a kidney, under such circumstances, is also diminished, but not to a very large extent. That all this is the result of the obstruction alone, is proved by the fact that if a recent hydronephrosis, whose fluid only contains 0·1 per cent. of urea, be drained through the loin by a carefully-fitting tube, the urine may rapidly regain its normal percentage of urea, &c., the resistance being removed. But where a hydronephrosis has lasted for a long time, it has been shown that the kidney becomes, at last, permanently damaged and incapable of secreting urea or even furnishing urine, except in traces. In such a case, not only is the pelvis enormously distended, but the kidney proper is found stretched into a thin, fibrous plate, as it were, which lies like a cap upon the upper and back part of the sac, covering, perhaps, an area of six or eight inches, and showing little or nothing of its original structure.

Prognosis.—If a hydronephrosis be left untreated, one of three results may be looked for. (1) It may go on enlarging until the patient is gradually exhausted by the distress due to its pressure upon other abdominal organs. (2) It may rupture, with or without external injury, the fluid escaping into the peritoneal cavity and causing peritonitis, or, in very rare cases, becoming absorbed without further mischief. (3) It may grow to a large size, and then, owing to the complete atrophy of the kidney as the result of pressure, it may, at last, become slowly absorbed again.

The best *treatment* for hydronephrosis is a problem yet to be solved. In a few cases, where the condition is due to blocking of the ureter by calculus, the latter may, perhaps, be helped to pass into the bladder by manipulation over the track of the ureter, aided by hot baths and the use of sedatives and antispasmodics. But this could only be possible in comparatively recent cases of obstruction. The same may be said of the operation of cutting down upon the ureter and opening it for the extraction of the stone. This procedure will, probably, be put in practice in the future, when we have collected sufficient facts for a positive diagnosis, but, although proposed many years ago, it has, so far, not yielded any fruit. Even if a urinary fistula remained after such an operation, still the gain to the patient would be great, for a time at all events, and would not very unfavourably influence any subsequent procedure chosen for the final relief. In the more chronic cases, where the seat of the obstruction cannot be defined, the surgeon now-a-days will not be inclined to await the possible atrophy of the kidney and absorption of the fluid, knowing the remoteness of the prospect and the risks constantly incurred.

There remain, then, only three measures for relief: (*a*) repeated aspiration, (*b*) free drainage, (*c*) excision of the sac and kidney together. There are, perhaps, a very few cases in which repeated aspiration at the point of election (*vide supra*) may be followed by permanent cure. They are those in which the secreting powers of the kidney are almost, or completely, destroyed, and we have simply to deal with a cyst whose walls are practically inert. But such cysts would require very frequently repeated aspirations before they could be brought to contract finally, if they ever did so. Free drainage of hydronephrosis is not much more successful than aspiration, and is not devoid of risks. Of course a large sac will be in a better position to contract if freely and continuously drained, than if only occasionally emptied. But the time consumed in the process is usually very great, and the patient often suffers great distress from the process of drainage, and the necessity, lasting for months, for constantly changing the wet dressings. Again, there is always the risk of suppuration in the sac, with consequent septic infection. This may usually be guarded against by careful antiseptic treatment of the opening, which should always be made at the point of election behind. If kept aseptic the drainage may prove useful in relieving the patient's immediate distress, and preparing the way, in suitable cases, for the more radical treatment of nephrectomy (q.v.) But if allowed to suppurate the sac will contract firm adhesions to the parts around, and the difficulties of the latter operation will be greatly increased if it be undertaken. It must, therefore, be carefully considered, in every case, whether it would not be better to proceed to the removal of the kidney at once, without complicating the case further, at all events after a sufficiently free but short drainage. There are cases where, undoubtedly, immediate nephrectomy is the best treatment. The patient's age and general state of health, taken together with the duration of the disease, are the only guides, but upon these points no definite rules can be laid down.

A. E. Barker.

HYDROPHOBIA.—A disease in man resulting from inoculation with the virus of a rabid animal, and characterised, among other symptoms, by spasmodic contractions of the pharyngeal muscles, and consequently by inability, in the majority of cases, to swallow fluids.

The morbific substance is contained in the saliva or oral mucus of the rabid animal, and is harmless when applied to an unbroken cutaneous or mucous surface. If introduced into the subcutaneous tissues it produces in animals rabies, and in man hydrophobia, provided that the individual so inoculated possess the requisite susceptibility for the disease. This would appear to be a necessary condition, from the fact that of persons bitten by rabid animals a large majority, variously estimated at from 60 to 95 per cent., escape without further consequences. This might be explained by the assumption that those who so escape were not inoculated, and that the poison had been intercepted by the clothing, or that, by precautionary treatment, the poison had been neutralised. In support of this is the fact that bites on the face, hands, or other exposed parts more frequently result in hydrophobia than when parts protected by clothing have been bitten. But the experiments of Hertwig seem to prove that in dogs such susceptibility is essential, as only 37 per cent. of the animals experimented upon became rabid. One dog, a pug, was fruitlessly injected nine times in three years with matter which induced rabies in other dogs. The recent experiments of Pasteur also appear to demonstrate the insusceptibility of some dogs to inoculation; for, although he was more successful than Hertwig in inducing rabies, three dogs, out of an unspecified number experimented on, proved to be insusceptible to repeated inoculations.

The symptoms of rabies in the dog and of hydrophobia in man are very different; but the fact that inoculation of dogs with the saliva of hydrophobic patients has induced rabies, establishes the identity of the diseases.

Inoculation is generally the result of the bite of a rabid animal, and dogs are the most frequent agents; but the bite of rabid wolves, foxes, jackals, hyænas, cats, pigs, and even herbivorous animals, has induced the disease. It does not appear to be proved that the animal must necessarily be rabid, so that precautionary treatment should be employed in all such wounds, whatever may be the condition of the animal. Some cases are recorded where the disease resulted from the scratch of a cat, whose claws were probably smeared with saliva. One case was caused by an accidental wound in the dissection of a dog which had died of rabies. Another case is said to have resulted from the patient having used his teeth to loosen the knots in a rope with which a mad dog had been tied. Such cases suggest the necessity of caution on the part of attendants upon hydrophobic patients.

Hydrophobia, compared with other acute specific diseases, is characterised by the long duration and variability of the latent stage. From recorded cases it would seem to vary from fourteen days to nearly as many years. But in the great majority of cases active symptoms manifest themselves within three months from the date of the wound, and in only six per cent. of 147 well-ascertained cases has the latent period lasted for more than six months. Very prolonged periods can therefore be only accepted with some reserve. The latent stage, or delitescence, is not marked by any characteristic symptoms. Some writers have observed unusual appearances in the wound or cicatrix, but these probably resulted from the treatment adopted; others have noted symptoms of mental disturbance for the first few days after the wound, naturally enough if the patients were aware of the risk that they had incurred. Marochetti's vesicles, or the so-called 'lyssi,' for some time attracted attention. They are vesicular or occasionally solid projections on the mucous membrane of the tongue, lips, or cheeks, which are said to form from the third to the twentieth day after the wound, and at one time the safety of the patient was believed to depend on their thorough extirpation. They are, however, not always found, and their significance has not been established.

In the active stage, or recrudescence, the first symptom which usually attracts attention is difficulty of deglutition. The patient when about to drink is checked by a sudden inspiratory spasm. In some cases this is preceded by sleeplessness and general malaise.

The patient now usually complains of a feeling of fulness and stiffness in the throat, of compression of the chest and difficulty of respiration, and of numbness, tingling, or neuralgic pains at the seat of the wound or its immediate vicinity. In one case, a boy aged fourteen, who had been bitten on the back of the right hand five months before the onset of acute symptoms, complained of such severe pain along the right ulnar nerve, which was relieved by pressure, that the writer was reluctantly induced to divide the nerve behind the internal condyle, without any benefit to the patient. Great restlessness and suspicious watchfulness are very marked at this stage. All the symptoms indicate disturbance of the central nervous system, especially of the lower part of the medulla oblongata, where the centres for respiration and deglutition are situated. As the disease progresses, hyperæsthesia is conspicuous. Convulsive spasms become frequent, and are excited not merely, as at first, by attempts to swallow fluids, but by any peripheral stimulation. A current of cold air, a flash of light, a bright colour, some glittering substance, a sudden noise, as the shutting of a door, trickling of water, or the mention or even thought of fluid, may excite them. These spasms especially affect the muscles, both ordinary and extraordinary, of inspiration, and are sometimes so prolonged as to threaten suffocation. Sometimes all the muscles of the trunk are convulsed, and there is marked opisthotonos. In the intervals the respiratory movements are shallow and hurried. The pulse is usually small and frequent. The salivary glands generally secrete abundantly, and the patient, being unable to swallow, expectorates in all directions. If the secretion be viscid the patient has much difficulty in getting rid of it. The tone of the voice is often altered from want of co-ordination of the muscles of vocalisation. Hence probably originated the old stories of hydrophobic patients foaming at the mouth and barking like dogs.

As the higher cerebral centres become involved the patient may have hallucinations, or even violent delirium. But these symptoms are not persistent, and the patient is usually intelligent and fully conscious of his miserable condition. His sufferings are aggravated by great thirst. Sometimes there is vomiting of bilious fluid. At the commencement of the acute stage there is not infrequently, in adults, increased sexual desire, and there is often priapism even in children. The urine is scanty, and generally contains albumen.

In the intervals between the convulsions the patient sometimes sleeps, especially if narcotics have been employed; but usually the sleep is restless and of short duration.

The acute stage generally lasts from one to two days—very rarely longer. It is succeeded, if death has not occurred, by a period corresponding to the paralytic stage of rabies in the dog. The convulsions either cease altogether or greatly abate in force and frequency. The power of deglutition is regained, but the patient is weak and feeble; the respirations and pulse are frequent; the skin is bathed in clammy perspiration; and death, apparently from exhaustion, speedily supervenes.

The above description is not applicable to all cases. Indeed, no two cases are exactly alike. In some mental disturbance, in others convulsive seizures predominate. Occasionally even the test symptom of difficulty of deglutition is altogether absent or exists in a very slight degree. Some writers explain these variations by assuming that there are varieties of the disease, but they are probably due to idiosyncrasy of the patient and varying powers of resistance in the nerve-centres.

Pathological Anatomy.—The early onset of rigor mortis and decomposition, the fluidity of the blood, and congestion of the fauces, lungs, and kidneys, have long been noticed in this disease. These, with minute ecchymoses beneath the pleura, pericardium, and membranes of the brain and spinal cord, are usually the chief macroscopic phenomena. Microscopically, degeneration of the ganglion cells in the nuclei of the tenth, eleventh, and twelfth cranial nerves, and, to a less extent, of the ganglion cells in the cortex of the cerebral hemispheres, with exudation into the peri-vascular spaces of the brain and spinal cord, especially in the medulla oblongata, thromboses of small vessels and miliary abscesses, have been discovered. Klebs, quoted by Reder in the *Deutsche Chirurgie*, 1879, found in the lymphatic and submaxillary glands granular, very refractive corpuscles of a pale brown colour, aggregated in longitudinal bands or in stellate groups, usually in the course of the blood-vessels, which may, as he suggests, be the vehicles in the transmission of the disease.

Treatment.—All wounds caused by bites should be thoroughly cleansed as soon as possible. Bleeding should be encouraged, and the wounds then be cauterised. In quite recent cases the solid nitrate of silver will suffice; but, if some interval has elapsed, nitric acid or the actual cautery should be employed. Some recommend excision of the bitten part; but this seems needlessly severe as a merely precautionary measure. Some simple dressing should then be applied, and the patient's mind should be diverted from the subject. When acute symptoms have appeared, all sources of excitement should be prevented. The patient should be kept in a darkened room, with as little physical restraint as possible. If attempts to swallow induce convulsions, nutrient enemata should be administered. No specific has been discovered for this disease. Mercurial inunction combined with hot-air baths has been apparently successful in a few cases. Hypodermic injections of curare, in doses of from $\frac{1}{16}$ to $\frac{1}{4}$ of a grain, may be tried; but the effect must be carefully watched, lest paralysis of the respiratory muscles supervene. Aconite, preparations of arsenic, atropine, calabar bean, cold affusion and ice to the spine, have been employed, but mostly without any advantage. Narcotics alleviate the symptoms, and of these morphia, administered hypodermically, and chloral hydrate by the rectum, appear to be the most efficacious. Anæsthetics prevent the convulsions while the patient is under their influence, but in some cases they cannot be tolerated. In the boy before alluded to, whose ulnar nerve was divided, the attempt to administer chloroform induced a dangerously long-continued inspiratory spasm. This has been observed in other cases also. Tracheotomy has been suggested, and, if the spasm were limited to the laryngeal muscles, would be most serviceable; but as all the muscles of inspiration are generally affected, the utility of the operation is not apparent. Quietude, narcotics, and nutrient enemata would appear to be the most suitable treatment.

The *prognosis* is very unfavourable, although a few cases of apparently genuine hydrophobia have recovered. Pasteur's experiments, which have not yet been completed, appear to indicate that dogs can be rendered insusceptible of rabies by being inoculated with the suitably attenuated virus of rabid animals. If this be substantiated we may look forward to the disappearance of hydrophobia, and prevention will indeed be better than the hitherto futile attempts to cure.

Diagnosis.—Hydrophobia so greatly resembles tetanus in some respects, that it has been proposed to classify it as a variety of that disease by the name of tetanus rabicus. From ordinary tetanus it may be distinguished by the duration of the period of incubation, by the absence of trismus, by the characteristic inspiratory spasm, and by the remissions during the acute stage. From the literature of hydrophobia it is evident that cases of acute mania and of hysteria have been mistaken for it, from the inability—real or pretended—of the patient to swallow fluid. But the absence of all the other symptoms of hydrophobia, and notably of the acceleration of the pulse, should suffice to prevent such mistakes.

JEREMIAH McCARTHY.

HYDROPS ANTRI. *See* ANTRUM, Diseases of the.

HYGROMA. *See* HYDROCELE OF THE NECK.

HYMEN, Imperforate. *See* VAGINA, Affections of the.

HYOID BONE, Fracture of the.—Embedded in the soft parts, and placed at the retiring angle between the prominence of the chin and the front surface of the neck, the hyoid bone is rarely fractured.

The cause is almost invariably direct violence, such as a blow, an attempt to throttle, or a fall upon some projecting object. This lesion is also frequently found in the bodies of those who have been hanged. Instances are on record in which it has followed a muscular effort, e.g. in yawning, or a sudden movement of the neck. The great cornu is the part usually broken, and one or other of the fragments may project through the mucous membrane of the pharynx. Most of the cases on record have been in adults.

Symptoms.—Pain in the part, aggravated by all movements of the tongue and pharynx, such as speaking, masticating, and swallowing. In some cases also the attempt to open the mouth or move the neck is painful. Swelling and ecchymosis will be observed in the upper part of the neck, or about the floor of the mouth. There may be huskiness or loss of voice, with coughing and occasionally severe dyspnœa. There is sometimes a free flow of saliva, which may be mingled with blood if the mucous membrane has been wounded. On manipulation the mobility of the fragments can usually be ascertained, and crepitus can be felt where there is not much displacement. By introducing the finger through the mouth the diagnosis will be assisted, and any projection of the fragments beneath or through the mucous membrane will be readily detected.

Treatment.—If there is displacement, the surgeon must endeavour by manipulation to reduce the fragments. By the help of a finger in the mouth and gentle pressure with the fingers of the other hand externally, this object may usually be effected. The patient should then be kept in bed, and must not be allowed to speak. By means of a bandage placed round the head and attached below to a broad belt round the chest, the movements of the neck should be prevented. Hæmorrhage should be checked by giving the patient ice to suck. In severe dyspnœa and laryngeal irritation it will be necessary to resort at once to laryngotomy; or, if the injury extend to the laryngeal cartilages, or the soft parts covering them, tracheotomy may be preferable. Liquid food and sops should be given, but if the attempt to swallow causes great pain and coughing, or if it displaces the fragments, it may be necessary to feed the patient with nutrient enemata. In some cases, however, this difficulty may be met by the use of an œsophageal tube.

To relieve the local swelling and pain, a lead and opium lotion may be used, and leeches are sometimes beneficial.

As a rule the more acute symptoms subside in a week or two, and the consolidation of the parts allows a certain amount of movement. Bony union takes place in the course of a few weeks. Occasionally necrosis of part of the bone, accompanied by the formation of foul abscesses, may cause great delay in the healing process, and the patient may succumb to the exhaustion or septic condition thus produced.

N. DAVIES-COLLEY.

HYPERIDROSIS (Excessive Sweating).—*Cause.*—Hyperidrosis may be (1) symptomatic in some general disease of a febrile character—rheumatism, pneumonia, &c.; or (2) it may depend on the debility induced by exhausting disease (phthisis). (3) It may be due to some affection more essentially neurotic in character, as in cases where it accompanies neuralgia or paralysis. (4) It occurs idiopathically, and may be regarded rather as an anomaly of function.

Pathology.—A functional disturbance of the sweat-glands, increasing the quantity of sweat secreted, but not altering its character.

Symptoms. — The condition may be acute or chronic, general or local. When accompanying febrile conditions it is more often general, and is sometimes attended by the formation on the surface of the skin of minute, evenly-distributed, and closely-set pellucid vesicles (sudamina). They are formed by small collections of sweat beneath the cuticle. Occasionally sudamina become somewhat turbid, in which condition they have received the name 'miliaria alba'; or they may be accompanied by a certain amount of inflammatory halo, and have then received the name 'miliaria rubra.'

It must be noted that excessive sweating is sometimes accompanied by a lowered temperature.

Local hyperidrosis is most frequently met with on the perineum and adjacent parts, axillæ, palms, and soles; but other forms of local hyperidrosis are met with, often unilateral, and as part of a local neurotic disturbance. The form of hyperidrosis which most often calls for treatment is the sweating of the palms or soles; this condition, which may be temporary or permanent, gives rise to great annoyance, interfering with an occupation, or with the patient's social duties and pleasures. The continued maceration may lead to changes in the skin between the fingers or about the perineum or adjacent parts—that is, to an erythematous eczema (intertrigo).

On the soles there are more often seen rounded patches of sodden, whitish epidermis, like that of the washerwoman's hand, the patches eventually desquamating and leaving the part beneath red and tender. Not infrequently the part drifts into a chronic desquamative condition, indistinguishable from eczema of the sole. This sweating of the feet is rarely unaccompanied by fetor, due to the proneness of the sweat to decompose after its deposit on the surface, or to the presence of a bacterium (Thin). Hyperidrosis is naturally worse in summer than in winter.

Treatment.—Quinine, iron, belladonna, or dilute sulphuric acid, may be given in cases where it may be desirable to treat the condition internally. The hypodermic injection of atropia (gr. $\frac{1}{100}$–$\frac{1}{50}$) is said to be of great service. In cases where the sweating is accompanied by debility, a general tonic treatment is obviously indicated.

It is, however, the local and more permanent varieties which call for treatment, and this is more likely to be successful when of a local character. Dusting powders, such as the following:—℞ Acidi salicylici, gr. xx.; zinci oxidi, ʒiij.; kaolin ad ℥j., may be perseveringly applied, after cleansing, night and morning; or the parts may be bathed in astringent waters—e.g. sulphate of zinc, alum, or acetate of lead, a drachm of either to the pint of water.

Tincture of belladonna, either pure or diluted, is well spoken of as a local application, but toxic effects should be watched for. For cases which resist such treatment, the following plan may be adopted:—The feet, after being washed and dried, are to be enveloped in neatly-applied dressings smeared with the following ointment—a modification of Hebra's unguent. diachyli: ℞ Emplast. diachyli, ℥iv.; olei olivæ, f ℥iv. The plaster to be melted, and the oil added, and stirred until a homogeneous mass results; bandages to be applied, and clean stockings and new boots to be worn. In twenty-four hours the feet are to be redressed in the same way after being wiped (not washed), and dusted with dusting powder. The treatment is to be carried out for ten to twenty days, after which the dressings may be discontinued, and the dusting powder only applied. The process may have to be repeated. Desquamation occurs, beneath which the epidermis is tender at first. ALFRED SANGSTER.

HYPERMETROPIA, a congenital or acquired error of refraction of the eye, in which, with the accommodation at rest, the focus of the lens-system of the eye does not lie upon the layer of rods and cones of the retina, but at an imaginary spot behind. The physical state may be a short antero-posterior axis, too low refractive power of the media, insufficient curvature of the refracting surfaces, imperfect growth of the crystalline lens, or absence of the lens. *See* REFRACTION, Errors of.

HYPEROSTOSIS. *See* JAWS, Diseases of the.

HYPERTROPHY, in its surgical sense, is the term used to indicate enlargement of an organ, or overgrowth of a tissue. When analysed pathologically, it will be seen to include the results of very different causes.

of increased nutrition. Thus, there are the PHYSIOLOGICAL HYPERTROPHIES which happen as phases of the normal life-history of the body. Amongst these may be mentioned the enlargement of the uterus incidental to pregnancy; and the changes that develop in the female breast at the age of puberty, and prior to lactation. It may be said generally that physiological hypertrophies are intended to provide the means for a quantitative increase of functional activity, and that when the functional call ceases the increment of tissue is removed by consecutive atrophy.

Then there are certain cases in which a part passes beyond the level of natural growth, either as a congenital deformity—e.g. an enlarged hand or foot—or as an acquired excess and perversion of nutrition. The latter are apt to arise at certain epochs of life, and this feature is not the least of their characteristics. Diffuse hypertrophy of the breasts in young women, and enlargement of the prostate gland in old men, are familiar examples. Now, inasmuch as there is no sufficiently obvious explanation of such overgrowths, they have been designated *spontaneous*—a very convenient expression, but one which gives no information.

In hypertrophy of the prostate the glandular, muscular, and fibrous elements are all multiplied, and amyloid bodies are formed with tolerable frequency.

COMPENSATORY HYPERTROPHIES are induced for the purpose of overcoming increased resistance to muscular action; or for substituted service where one of duplicate glandular organs is, from some cause or other, crippled in its function. Numerous illustrations of the former group are met with in practice—e.g. stricture of the urethra entails hypertrophy of the bladder and ureters; stricture of the rectum a like condition of the contractile coat of the bowel above the seat of obstruction. The heart undergoes marked enlargement from incompetency of the valves or stenosis of the cardiac orifices. In these cases dilatation supervenes on the hypertrophy when the limit of compensation is reached, or, in other words, when the mechanical impediment interrupts the vascular supply of the muscles involved. In children, the bladder is occasionally hypertrophied without there being any recognisable obstruction to the flow of urine; indeed, it would seem that mere excess of function from long-continued derangement of the nervo-muscular dynamism—commonly known as 'irritable bladder'—is sufficient to account for the overgrowth of the vesical muscles. Elongated prepuce, ascarides, and polypus of the rectum may be the initial cause of the mischief, but, on the other hand, the functional disturbance may be purely intrinsic.

Hypertrophy is more common and more pronounced in the involuntary than in the voluntary muscles—(1) because the former are subject, in their normal state, to perpetually recurring frequent stimulation, and (2) because in them unusual resistance is more liable to arise and more difficult to remove. Up to a certain point the voluntary muscles grow in response to the extra call on their contractility, but beyond this the repair, during the shortened intervals of rest, is not equal to the loss sustained by over-exercise. When the muscular fibres are merely enlarged, the hypertrophy is termed 'simple;' when they are multiplied, it is called 'numerical.'

The disease known as *Pseudo-hypertrophic paralysis* (q.v.) affects the voluntary muscles, especially those of the calves. As regards the muscular fibres, it is essentially an atrophic change, the apparent hypertrophy depending mainly upon fatty infiltration within and without the sarcolemma.

When one kidney is undeveloped or atrophied, the other grows to meet the requirements of the system. The existing urinary tubules—and notably the secreting cells—are increased in size, and probably new ones are formed.

IRRITATIVE HYPERTROPHIES.—The stimulus to increased nutrition is an artificial one, and its incidence often owing to chance. The results, which in the gross are classed with the hypertrophies on account of the bulk acquired, are largely inflammatory overgrowths, modified in each case under the influence of the special formative property of the tissues implicated. Intermittent pressure is a common cause of hypertrophy (continuous pressure leads to atrophy). It acts by teasing the structural elements into greater nutritive activity, and by determining an extra supply of blood to the part.

The pressure of tight and badly-fitting shoes is a fertile source of corns. Misdirected pressure, as when, through varus, the weight of the body is thrown on the outer surface of the foot, causes thickening of the skin and effusion into the subcutaneous tissue. The effusion is often so collected and circumscribed as to constitute a bursa, over which the callosity glides. The papillæ and hairs on the outskirts of chronic ulcers of the leg are always hypertrophied; and so, commonly, is the underlying bone, which is then marked by a flattened node with well-defined margin.

Elephantiasis Arabum, a diffuse overgrowth of the skin and subcutaneous connective tissue, is a good example of irritative hypertrophy. It affects chiefly the scrotum and legs of Orientals.

Probably no other tissue shows such diversity in the degree and manner of hypertrophy as the osseous. In atrophy of the brain the cranium responds with concentric hypertrophy; and when the cranial contents are amplified, eccentric overgrowth of the encasing bone is the usual concomitant. Thickening of the cranial bones, with filling in of the diploe, is one of the features of senility.

Hypertrophic lengthening of a long bone may be due to some constitutional state—e.g. syphilis; more rarely it is complementary to shortening of another bone of the same or the opposite limb. Then there are those curious cases known as 'ostitis deformans,' in which a few, many, or most of the bones in the body are distorted by massive deposits and curvatures. Equally interesting, and puzzling as to its intrinsic nature, is the occasional progressive hypertrophy of the facial bones. 'In such cases the bony deposits are spongy, puffed, nodular, so that the bone acquires a resemblance to skin affected with elephantiasis.'—Billroth. Augustus J. Pepper.

HYPOCHONDRIASIS (in the male), a mental condition, usually hereditary, akin, and often the prelude, to melancholia, characterised by great depression and a tendency to exaggerate or imagine symptoms of some physical ailment or defect.

In surgical practice it is generally met with in association with bleeding piles, so-called fissure of the anus, urethral stricture, apprehended impotence, varicocele, &c. Any local affection attended with pain, loss of blood, or prolonged purulent discharge will, in persons of feeble nervous organisation, react upon the system and increase the hypochondriacal tendency. Appropriate and successful treatment of the local ailment will therefore produce considerable improvement in the mental condition. But if there be no objective local ailment, the prognosis is very unfavourable.

If hypochondriasis be complicated by varicocele, the patient usually attributes his condition to this cause, and complains of aching pains and abnormal sensations in the corresponding testicle or spermatic cord. But varicocele very rarely requires operative treatment, and experience has proved that its removal in these cases does not benefit the patient, who still complains of pains when the supposed cause has ceased to exist.

Apprehension of impending impotence is a frequent symptom. The patient's thoughts are engrossed with the subject. He studies all his symptoms, and is alert to discover additional evidence of his incapacity. Stimulated more by curiosity as to his condition than by appetite, he attempts sexual intercourse, and if anxiety as to the result produce failure, as not infrequently happens, his mental depression is correspondingly increased. Such patients often volunteer confessions of self-abuse or of premature and excessive indulgence in venery. These aberrations are, in part at least, due to defective mental control; but indulgence in them reacts injuriously on the nervous system. Hypochondriasis is frequently met with in hospital practice, and many cases of so-called malingering are due to this cause. The patient wastes his life in going from one hospital to another, without benefit to himself or satisfaction to his surgeon.

The diagnosis of hypochondriasis is not difficult. The patient's exaggerated complaints and unusual sensations, without any objective cause, sufficiently indicate his condition.

Treatment.—Any local source of pain or irritation must be appropriately treated; but the ministering to a mind diseased belongs more to medical than to surgical practice. Jeremiah McCarthy.

HYPODERMIC INJECTION.—By this term is understood the administration of drugs by injecting them in a concentrated form beneath the skin, into the lymph spaces, from which they are readily absorbed into the general circulation. This method possesses the following advantages:—(1) Rapid effect of drug; (2) more powerful effect produced; (3) direct local effect on tissues, especially nerve-trunks; (4) avoidance of direct disturbance of alimentary canal; (5) economy.

A. *Operation for Rapid Absorption.*—Care having been taken that the small hypodermic syringe is perfectly clean, and that the washer of the piston is supple and airtight, a sufficient quantity of the drug is drawn up into the body of the syringe, and all air excluded by turning the needle upwards and pressing the piston. The skin on the back of the forearm or elsewhere having been pinched up for about two inches and stretched tightly, the needle is driven, with a single rapid thrust, deeply into the subcutaneous tissue, into which the fluid is then slowly injected; the needle is then as rapidly withdrawn, and the thumb placed on the puncture to prevent a possible slight oozing of the fluid injected.

Points to be noted in connection with the foregoing are—

(1) Syringe: the barrel should be of glass, upon which are directly screwed the fittings at each end. Minim or cubic millimetre divisions should be marked on the barrel, and not on the piston-rod, on which, however, should be placed an adjustable stop. The piston should have a double cup-shaped washer, the halves being separated by a groove. If the washer becomes dry it is always best to soak it in warm water. Before and after use, the syringe and needle attached should be washed thoroughly in pure water, the needle dried, and a wire inserted in it.

(2) Fluid, to be injected, must be in as small a quantity as possible without being so concentrated as to cause irritation on that account. (The irritative effect of many drugs can be avoided by judicious combination with atropia, &c.) If the quantity to be injected exceeds 15 minims or 3 cubic

Drug	Dose	Employment	Remarks
Acetic Acid	5 minims of 10 per cent. solution.	Check to new growths	Should be injected into growing margin. (Broadbent.)
Carbolic Acid	5–10 minims of 8 per cent. solution	To check infective inflammation and new growths.	In malignant pustule has been injected, 5–20 per cent., under pustule.
Lactic Acid	5 minims of 10 per cent. solution.	Check to new growths	Should be injected into growing margin. (Hüter.)
Osmic Acid	5 minims of 1 per cent. solution.	„ „	Causes pain and inflammation.
Sclerotic Acid	3–5 m.	Excitor of involuntary muscular action in gut and uterus. Hæmostatic.	Far better than ergot. Inject into buttock deeply.
Bromine	1 m.	Check to hospital gangrene	Of doubtful value.
Iodine	1 gr.	Check to new growths (goître, &c.).	
„	$\frac{1}{8}$–$\frac{1}{4}$ gr. (10 m. Tinct. Iodi, or more.).	Strumous glands, tonsils, &c. Radical cure of hydrocele, &c.	
Iodide of Potassium.	3–5 gr.	Check to new growths. Chronic inflammatory disturbance.	Less powerful than iodine.
Arsenic	4 m. of Liq. Arsenic, + equal quantity of water.	Check to new growths, &c.	Painful.
Ferric Perchloride	3–5 m.	Radical cure of nævus, &c.	
Liq. Ferri Perchlor.	10 m.	Check to new growths	
Mercuric Perchloride.	$\frac{1}{16}$ gr.	Cure of syphilis	Should be combined with atropia and morphia.
Ammoniæ Liquor	10 m. in f℥j. of water.	Cardiac stimulant in shock, &c. Antidote to alcohol, opium, and snake poison.	Must be injected into a vein. Danger of local inflammation.
Sulphuric Ether	5–10 m.	Cure of epileptiform neuralgia, sciatica, &c.	Deep injection down to nerve-trunk.
„ „	20–30 m.	Cardiac stimulant in shock or syncope from anæsthetics, &c.	Should be injected beneath skin of breast.
Chloroform	5 m.	Local anæsthetic	Painful at first.
Aconitia	$\frac{1}{200}$–$\frac{1}{64}$ gr.	Check to neuralgia	Best to begin with small dose.
Apomorphia	$\frac{1}{25}$–$\frac{1}{6}$ gr.	As an emetic	Invaluable as emetic. Acts in 2 minutes.
Atropia	$\frac{1}{100}$–$\frac{1}{10}$ gr.	Antidote to opium, chloroform, pilocarpin, muscarin, aconite, &c. Checks excessive secretion.	Valuable to combine with other injections to reduce inflammatory mischief.
Cocaine	$\frac{1}{8}$–1 gr.	Local anæsthetic. Checks congestion of mucous membrane of nose, &c., &c.	Usually in 4, 10, or 20 per cent. solution. Inject 2–4 m. of last.
Curare	$\frac{1}{3}$–$\frac{1}{2}$ gr., or 4 gr. in 24 hours.	To cure tetanus and hydrophobia.	Of doubtful value. Only danger is paralysis of respiratory muscles.
Ergotin	$\frac{1}{3}$ gr., in water	Hæmostatic, &c.	Best to use sclerotic acid, q.v. If neither can be had, use 10 m. of Liquor ergot. ammon. and $\frac{1}{4}$ gr. morphia and $\frac{1}{50}$ gr. atropia.
Eserine	$\frac{1}{100}$–$\frac{1}{50}$ gr.	To cure tetanus	
Hyoscyamin	$\frac{1}{100}$–$\frac{1}{20}$ gr.	Checks delirium of mania and delirium tremens.	
Morphia	$\frac{1}{4}$–$\frac{1}{2}$ gr.	Anodyne. Hæmostatic. Writer has found, with Prof. Schafer, that it diminishes parenchymatous oozing when given just before operation.	Combine with $\frac{1}{60}$ gr. atropine.
Pilocarpin	$\frac{1}{10}$–$\frac{1}{2}$ gr.	To produce sweating in cases of uræmia, &c.	Very useful combined with hot-air bath.

centimetres, it had better be divided, and each part injected in a different place.

(3) The point at which injection is to be made should usually be in the limbs, on the extensor surfaces, where the skin is loose. Least pain and tension will follow where the skin is loosest.

Deep injection is recommended by some, and then the needle is thrust, to the head, vertically into the muscles of the buttock or back.

(4) *Accidents.*—(*a*) Inflammation may be caused by want of cleanliness in the needle, &c., decomposition of the fluid to be injected (growth of fungi, &c.), excessive quantity of fluid injected, inflammation being set up by simple tension. (*b*) Injection into a vein, and consequent toxic symptoms from too rapid absorption of drug. These can all be avoided by ordinary attention.

B. *Operation for Interstitial Injection to check New Growths.*—Tumour to be cleansed, pedicle to be constricted, if possible, during and for a short time after injection. The needle is to be thrust deeply into the substance of the growth, the skin having previously been drawn aside to ensure a valvular guard to the puncture in the growth. Points to be noted are—

(1) Avoidance of vessels; accurate filling of syringe; thrusting the needle in first, and waiting to see (by flow of blood through it or not) whether it may chance to have penetrated a large blood-vessel; injection to be slow; quantity of fluid to be small at first sitting, viz. up to fʒj., or less if in such a position as the tonsil, &c.

(2) Accidents are—(*a*) Inflammatory disturbance, to be treated in the ordinary way; (*b*) injection into a vein, which may be fatal; this event to be avoided by observing the flow of blood from the needle, as just detailed.

C. *Operation for Checking Spread of Acute Specific Diseases.*—(*a*) To check spreading inflammation, such as erysipelas, hospital gangrene, traumatic gangrene, &c., inject beneath skin (in cases of gangrene, deep injection must be made as well) $\frac{1}{2}$ inch or about 1·5 cm. in front of the red margin of inflammation, at points about $\frac{1}{3}$ inch or 1 centimètre apart, 5–10 minims or about 2 cm. of fluid. (*See* table.) Has also been used (with very concentrated fluids) in malignant pustule.

Special modes of injection are referred to under the various drugs employed.

The drugs given are all soluble either directly in water or glycerine and water, or in water when they are in the form of salts —e.g. sulphates, &c. VICTOR HORSLEY.

HYPOPIUM. Pus in the anterior chamber of the eye. *See* HYPOPYON.

HYPOPYON denotes a collection of pus in the anterior chamber of the eyeball. It is distinguished from ONYX, which is an infiltration of pus into the lower part of the cornea, by being movable and shifting its position with the movements of the head, so as to gravitate to the most dependent part of the chamber. Its Latin form is hypopium. *See* CORNEA, Inflammation of the; IRIS, Diseases of the.

J. TWEEDY.

HYPOSPADIAS.—This deformity of the male generative organs is one common enough to attract the attention of most surgeons in practice, and is sometimes distressing enough to justify and even to call for persevering attempts to relieve it. It has been the fortune of the writer to see a great number of these cases during the last twenty years. The larger proportion of them have been comparatively slight cases, characterised only by an absence or a bifurcation of the frænum preputii. Usually, absence of a true meatus urinarius, and a backward position of the urethral opening, varying from a quarter to half an inch, were associated with this condition of the prepuce. In all cases, a deficiency of the prepuce at the under part of the glans penis is evident. In most, the prepuce is, on the other hand, redundant upon the dorsum of the penis. This redundancy, in many forms of the malformation, assumes a shape somewhat similar to a hood or cowl, concealing the glans penis as seen from above and in front. At the sides of the corona glandis it slopes off, and is lost on the skin of the penis at the side of the urethra, so that the frænum preputii is split like a hare-lip.

In most of the severer cases, the body of the penis, near the glans, presents a decided downward curve, always more evident during the state of erection. In some cases, the curve thus increased during erection becomes an obstacle to coition, even without any extremely backward position of the meatus. In such cases, the penis as an organ of micturition is efficient, but as an instrument of coition is not so. The curve depends, in all the instances the writer has met with, upon the presence of a rigid band of fibrous tissue, forming the under surface of the corpora cavernosa. This band (which is apparently the result of an attempt to repair or supplement the deficient development of the corpus spongiosum of the urethra) being devoid of erectile tissue, does not accommodate itself to the changing bulk of the corpora cavernosa during erection, and, by its passive resistance, causes the downward curve of the penis peculiar to these cases.

In all the cases met with by the writer, the urethra has been more or less deficient in the proper development of its enclosing sheath of erectile tissue, the prolongation forward of the corpus spongiosum. Its walls are usually formed of mucous membrane, invested by a thin layer of fibrous tissue, which lies under a delicate and fine skin, and is a prolongation of the fibrous investment of the erectile tissue forming the bulb of the corpus spongiosum penis. The fossa navicularis is usually imperfect or entirely absent. The meatus urinarius is a transverse slit, forming a valvular aperture more or less contracted, and sometimes admitting only a fine probe. It may be the cause of a difficulty in micturition and trouble soon after birth. The opening varies in its position, being from a quarter of an inch or so posterior to its normal site, or extending to the base of the penis at the junction of the scrotum with the skin covering the penis, or even into the perineum beyond the scrotum. Frequently there is seen at the base of the penis a sort of navicular depression, indicating the abrupt termination of the bulb of the penis, even when the urethral aperture is placed considerably anterior to it. Between this depression and the actual opening the urethra in these cases is covered by a thin membranous skin, in addition to its mucous and fibrous investment. The skin on the under surface of the penis is generally thin and imperfectly developed, and often looks like an old cicatrix. In one remarkable case of the writer's, occurring in a young and vigorous man of the age of eighteen, this depression at the root of the penis was very marked, the urethra being, however, completed nearly as far as its normal termination by a thinner and finer skin. Although the urethra in this case was completed, and tolerably efficient as a micturating channel, the fibrous bands on each side of the urethra previously described were so thick and rigid that, when erect, the penis behind the corona glandis was bent almost double by their resisting action, so as to render coition quite impossible.

In a certain proportion of cases this deformity assumes a still more remarkable character. The cleft is continued backwards through the scrotum and into the perineum, separating the two halves of the scrotum into two labia, similar to the labia majora of the female. Each of the labia, however, is rather fuller, broader, and more pronounced than in most female children, and usually contains a testicle in a more or less perfect state of development. The urethral groove is continued backward through the anterior half of the perineum, completely severing the two halves of the corpus spongiosum, and ending at the membranous portion of the urethra in a distinct fourchette, resembling that of the vagina in the female. Often, in these cases, there is a prominent valve-like formation of a crescentic shape, somewhat similar to the virgin hymen, and still further increasing the resemblance to the female. When this condition is accompanied by an imperfect evolution and non-descent of the testicle, the resemblance is so close as to afford a real excuse for the common mistake as to the sex of the individual.

Some of these individuals, in whom the testes, although present in the upper part of the labia, are small and ill-developed, have been mistaken for females in whom the ovaries have been drawn down into the labia. Many such cases are recorded. The author, however, considers that all, or nearly all, these persons have been really males. He has never seen one in whom the evidence has been unmistakably in favour of a really feminine condition. They are never, so far as he has seen, provided with a vaginal canal, distinct and separate from the urethral one, and the uterus is altogether absent, the prostate often doing duty as a witness in evidence of that organ. The diagnostic signs most to be depended on are the absence of both vagina and uterus, on examination by the finger *per anum*, with a sound passed through the urethra into the bladder; and the passage of the urine through the opening which has the external appearance of a vagina.

The family history of cases of *hypospadias* usually shows, like that of hare-lip, cleft palate, ectopia vesicæ and epispadias, and other deformities resulting from deficient evolution or arrest of development, a distinctly hereditary tendency. In many families of boys, some degree of the deformity may be observed in more than one, and although the difficulties of ascertaining the atavic peculiarity in such cases are great, from the peculiar position and obscure indications of the slighter cases of the deformity, enough can often be gathered to show that there is a family proclivity. In extreme cases only is it the cause of impotence, and thus the race is continued so long as the less serious results only are present in the individual bearer of the peculiarity. Some curious and valuable evidences of this are given by Mr. A. Lingard in the *Lancet* of April 19, 1884.

Treatment.—The slighter cases of hypospadias, in which the deformity is confined to the prepuce, frænum, and fossa navicularis, the penis serving more or less perfectly to carry the urine away from the clothes in micturition, may with great propriety be left alone. No attempt should be made to improve the slight deformity, which is by no means conspicuous. In more severe cases, where the urethra is open to the extent of its anterior half, the writer has succeeded in carrying forward the urethral tube to the end of the penis by transplanting the redundant dorsal portion of the hood-like prepuce, making a transverse incision or button-hole close to the coronal groove on the dorsum, and passing the glans penis through the aperture. The under surface of the penis was denuded of skin by turning over the urethral groove two lateral flaps, reversed, with the skin surface turned to the urethra, and reaching as far back as the groove extends along the urethra. These were stitched together by a continuous or glover's suture of fine carbolised catgut. The transplanted dorsal hood was then split up into two layers at the cut edge, which was opened and spread out over the raw surface of the reversed urethral flaps, and stitched to the edges by closely applied sutures of fine silver wire. At first, the transplanted prepuce looked rather lumpy, but this was soon diminished by the subsequent contraction, and served well the purpose of conducting the urine so as to make a definite and compact stream, clearing the clothes of the patient.

When the deformity extends as far back as the scrotum, it is usually necessary to take a flap from the front part of the scrotal integument, to eke out the deficiency of the prepuce, and to cover, when transplanted, the whole of the penile urethra. These cases usually give more trouble to cover the urethral groove, an imperfect union of the reflected and transposed flaps often resulting. They are still further complicated by the chordee or downward curvature of the penis during erection, resulting from the more complete arrest of development of the corpus spongiosum urethræ. They usually require operations for the cure of the chordee *previously* to the attempt to cover the urethra.

The writer has, in some cases, succeeded in diminishing to a great extent the degree of the downward curvature of the penis when erect, by making numerous transverse subcutaneous sections of the hardened and thickened tissues on each side of the urethral groove, and keeping the penis strapped upon a couple of thin metal splints covered with red rubber. The splints used were curved slightly in the opposite direction to the penis, so as to keep the latter upon a slightly convex surface. They were held on by india-rubber bands, which could easily be removed for the purpose of micturition. Two or three minor operations were usually required to obtain the best possible results. The cases, in which the imperfection of development is so great as to leave the genital organs in a condition resembling that of the female sex, require more extensive operations, but these are usually more directly and completely successful than those last described.

The result in the last case operated on by the writer, six months ago, was more than usually favourable. It occurred in a young man about twenty-one years of age who, up to the age of eighteen, had been trained and dressed as a female. It was not until the voice changed and the appearance of a beard and whiskers that suspicions were aroused as to his real sex. The penis was about the size of that of a boy of ten years, and the glans fairly formed and developed, but imperforate. The urethra was open as far as the perineum, the scrotum split into two labia majora, in each of which an oval, very movable, testis could be felt. When pressed upon, these gave to the patient the testicular sensation felt by a male subject. At the posterior extremity of the urethral groove was a lunated fold, with the general appearance of the fourchette and hymen. The aperture leading to the bladder was rather larger than the diameter of the prostatic and membranous urethra in a male of that age, but the compressors of the urethra were present, and acted completely in the retention of the urine. The urine escaped in a diffuse stream from the orifice, and the patient was obliged to sit down like a female to pass the water with comfort. On examination *per anum* no uterus or vagina could be felt, but the prostate, traversed by the sound when introduced, could be distinctly made out. The nymphæ were fairly represented by the folds of the split prepuce. An attempt was first made, by paring these folds and the sides of the urethra down to the perineum, to unite them simply in the median line over a gum elastic catheter, by the use of thin silver wire sutures closely applied. This plan, however, totally failed. A second operation was more successful.

This consisted in dissecting up each of the halves of the scrotum freely, along the whole length of the sexual opening, laying down one flap, reversed, upon the urethral groove (denuded of skin on each side), and placing upon its raw surface the raw surface of the other side by the plan of reversed and superimposed flaps described under EPISPADIAS: *see* ECTOPIA VESICÆ and EPISPADIAS. These were closely stitched together with a large number of silver wire sutures, which were kept in for several weeks until the flaps were firmly grown together. Some straggling hairs, growing from the skin surface of the reversed flap, were destroyed by the application of a drop of strong nitric acid applied to the root of each hair, which removed them before the principal operation was done. The union took place all the way up to the glans penis, forming a very perfect substitute for the lower urethral wall.

The patient could pass his water over the clothes in a very fair stream, with some dribbling towards the end of micturition. The testes remained in the folds of the scrotum on each side of the perineum, and gave no trouble. The whole appearance of the genitals now left little doubt as to the sex of the patient.

Operations of the kind just described require on the part of the patient much confidence and some powers of endurance; and on that of the surgeon much previous consideration, ingenuity, and fertility of resource. Repeated attempts will often succeed in the long run, when the case appears to be hopelessly incurable. With care and caution in arranging the operation, the patient need rarely be left in a worse, even if he do not attain to a better, condition through the efforts of the surgeon.

JOHN WOOD.

HYSTERECTOMY. *See* UTERUS, Extirpation of the.

I

ICHTHYOSIS.—*Definition.*—A general disease of congenital origin, characterised by extreme dryness of the skin, and more or less development of scales, epidermal plates, or warty-looking growths.

Etiology.—The disease is due to some congenital defect in the cutis, and is hereditary in many cases, but by no means in all The heredity may be direct, may skip a generation, or may be through a lateral branch. Sometimes, only one child in a large family will have it; at another, several children in the family, often keeping to the same sex, which may be either the same or the opposite to that of the affected parent; but, taken as a whole, both sexes and all classes are equally liable to it. There is no other known cause for the congenital affection, but a local condition resembling I. simplex is sometimes seen after injuries or disease of nerves. Epidermal and papillary hypertrophy is also seen sometimes in chronic inflammatory conditions looking like ichthyosis, but these are referable to elephantiasis arabum.

Varieties.—Ichthyosis, in one or other of its forms, is a fairly common disease, but varies immensely in its development. Three clinical types may be recognised: the first two are general, and are called xeroderma and ichthyosis simplex; the third, ichthyosis hystrix or hystricismus, is usually more or less localised. All of these varieties are congenital. The two general forms are not really distinct, the milder form being connected by every gradation with the more severe, but their separate consideration makes the clinical description clearer.

Symptoms.—Xeroderma is the commonest and mildest form; in it the skin is dry, rough, and dirty-looking, with the natural lines more marked than usual from the thickening of the epidermis; the roughness is produced by slight furfuraceous scalyness, and also by the prominence of the hair-follicles due to the condition known as keratosis pilaris, which is always present, often in a high degree, on the extensor surface of the limbs and trunk.

In ichthyosis simplex the whole surface has a tessellated appearance, from being covered with large, angular, dirty-white, finely corrugated, papery scales, which are adherent, and therefore slightly depressed in the centre (I. scutellata of Schönlein), while the edges are detached, transparent, and shining (I. nacrée of Alibert, or I. nitida). This and the following variations are often best seen on the leg, where the surface is frequently glistening above, with thicker scales below. In still higher grades, the scales adhere together to form thin plates, and being of a green tint look something like a serpent's skin (I. serpentina); when there are still thicker plates the appearance of a crocodile's hide is produced (Sauroderma). The older the plates, the darker they become, so that they may vary from an olive green to black (I. nigricans). A form of seborrhœa is sometimes called I. sebacea. While all these fanciful names are to be met with in literature, and are therefore explained, their use should be avoided as they only produce confusion. These extreme conditions are rarely extensive, and only occupy certain regions, a milder form prevailing elsewhere.

Although a general disease, it is unequal in its severity in different regions, and is always more developed on the extensor surfaces, especially over the tips of the elbows and knees and just above the ankles, where it may attain to the higher condition of warty growths or plates, even when the disease is moderate elsewhere; on the other hand, the flexures are comparatively free, often appearing quite normal. The palms and soles are often not much affected, except in the worst cases, but are nearly always harder and smoother from the absence of the smaller natural lines; the limbs are worse than the trunk, and the legs than the arms. The nails may be pitted and brittle, the hair is dry and harsh, and the scalp branny, while the face, though relatively less affected, is rough, and very often eczematous. In bad cases, there may be ectropion from contraction of the dry skin.

Itching is frequently experienced, especially when the clothes are taken off, but it is never severe unless eczema is present, to which the ichthyotic skin is very liable when exposed to cold, which may also produce painful fissures or chaps. The fully developed ichthyotic skin does not perspire sensibly, but some sweat may be seen in the flexures, especially the axillæ, and occasionally on the palms, soles, and face; the patients feel much relieved by it, and their condition is usually notably ameliorated in the summer.

Ichthyosis hystrix differs in so many ways from the other forms, that many regard it as a totally different affection, but there are connecting links with the commoner forms.

It is never general, though it may be widely distributed, and occasionally certain parts may be in the hystrix condition, while the rest of the skin may be xerodermatous; but in the majority of cases the intermediate skin is quite healthy. Moreover, it is seldom symmetrical and is often unilateral—sometimes sharply limited on the trunk by the median line—and frequently recognisably distributed in the course of the cutaneous nerves; hence it is usual to see it in lines running longitudinally on the limbs and transversely on the trunk, while the face is rarely affected, and then in a minor degree; in other cases the nerve-distribution cannot be traced.

The lesions vary from a small pin-point-sized papillary growth, covered with a horny cap which forms a nail-head-like prominence on the skin, up to warty or dark greenish, vertically striated, horny masses, with a wide base and truncated conical shape like limpet shells, projecting half an inch or more above the surface; when the horny part is soaked or pulled off, hypertrophied papillæ are brought into view.

Inconvenience is only experienced when the growths are in awkward positions, such as the palms and soles, on which they are common, or when the horny tops are torn off too roughly by catching in the clothes, &c.; but they are often shed spontaneously without any pain. Mental weakness is sometimes associated with very extensive cases of I. hystrix, and asthma is said to be more frequent among ichthyotic patients. In a unique unilateral case of Dr. Church's the mucous membrane of the cheek, soft palate, and tongue was affected on the same side; but for this exception it might be said that ichthyosis never affects the mucous membranes, the so-called 'ichthyosis linguæ' being an acquired affection of a totally different origin.

Course.—Although doubtless congenital, the skin does not usually show any abnormality for some weeks or months after birth, though a few cases have been born with it; while the higher grades are not attained to before the second year or later. This does not apply to I. hystrix, which develops sometimes quite early, and even at birth may show some signs of its presence. The disease tends, on the whole, to get gradually worse rather than better as the patient grows up, though there may be some remissions according to the season and to the amount of attention given to the skin. After full adult age is reached, some improvement appears to take place in cases of moderate severity.

Pathology and Morbid Anatomy.—There is evidently some congenital defect in the development of the cutis, chiefly of the epidermal layer; this is saying little, but we are unable at present to go further.

The morbid anatomy of ichthyosis simplex has not yet been made out; that of I. hystrix has been investigated by Kaposi and the author. The author's observations are here given:—In a horny growth the papillæ and their vessels are much enlarged, the Malpighian cells adjacent to the papillæ being normal, but instead of the intermediate layers of cells which in health fill or, so to speak, level up the inter-papillary spaces and so form a nearly plane surface on which the horny layers rest, the strata of horny cells dip deeply down into the inter-papillary spaces; so that the hyperplastic corneous layer follows the outline of the papillary layer, with a comparatively thin layer of rete cells intervening, in this particular differing from ordinary warts.

Diagnosis.—The diagnosis seldom presents difficulties. The disease dating back from a few months after birth; the general distribution; the dry, rough skin of xeroderma, the scales and plates of I. simplex, and the warty growths and nerve-distribution of I. hystrix are so characteristic as to leave no room for error, and the date of its onset will distinguish it from those secondary local conditions which resemble the congenital cases. When, however, extensive eczema complicates xeroderma, there is a great resemblance to prurigo, the more so as prurigo also commences in the first year of life; but the date of the onset of the eczema, the absence of prurigo papules and the enlarged glands, together with the result of treatment, will get over the difficulty.

Prognosis.—The prognosis is decidedly bad for its curability. Temporary amelioration can always be afforded in I. simplex, and, if the patient will take the daily trouble, the skin can be kept supple and free from discomfort. In very mild cases, steady perseverance for years with judicious treatment has effected a cure. I. hystrix is very hopeless as a rule, but a permanent removal of the growths, where the development has not been very great, may sometimes be effected.

Treatment.—This must be directed to removing the scales, and then making and keeping the skin pliable.

The first indication is best fulfilled by alkaline and bran baths, and friction in the baths, preceded, in bad cases, by soft-soap inunctions; the removal of the scales must be followed by inunctions of glycerine ointment or lotions, and animal and vegetable fats, vaseline or other petroleum fats. Almost any fat will do, such as lard, cold cream, neat's-foot, olive, and almond oils, or cod-liver oil; the last is very effectual, but too disagreeable. Kaposi speaks very strongly in favour of a 5 per cent. napthol ointment, in conjunction with napthol soap. Whichever is selected should be well rubbed in twice a day at first; but glycerine lotion will be found the most convenient application for the face and hands, in the strength of 1 to 10. Steady employment of these applications will soon render the skin quite smooth and supple, and the patient will seem to be quite cured; but this state can only be maintained by inunctions two or three times a week and frequent baths, or the disease will very soon return, and only requires time to resume its former severity. Eczema as a complication requires treatment appropriate to that condition; callosities can be softened by strong potash lotions (1 to 2) or continuous applications of soft soap or salicylic acid plaster. The larger growths of I. hystrix should only be interfered with if they are in inconvenient positions, and can then be excised or scraped with a sharp spoon.

The smaller papillary growths may be removed by the continuous application of tar ointment, and though many of them return, some will be permanently removed. A pleasanter application, and one which has been more successful than tar in the hands of the author, is to paint the growths, after removing the horny caps, with a saturated solution of salicylic acid in alcohol. Internal treatment in all forms is absolutely useless. H. Radcliffe Crocker.

ILIAC ABSCESS. *See* Psoas Abscess.

ILIAC ANEURISM.—The term 'iliac aneurism' is applied to all aneurismal tumours in connection with the common, external, and internal iliac arteries. The disease is most common in the lower part of the external iliac artery, at its junction with the femoral ('inguinal aneurism'). The internal iliac is rarely affected.

Etiology.—The causes are those of aneurism in general. Syphilitic disease of the vessels appears, however, to be a relatively frequent source of the lesion, while a history of a violent strain, as in lifting heavy weights, or some other traumatic influence, may often be traced. It is most commonly found in men, and about the middle period of life.

Symptoms.—The first sign usually noticed by the patient is the appearance of a pulsating tumour in some part of the iliac fossa, in the course of the common or external iliac artery. The form of the tumour is generally oval, but, when encroaching upon the common femoral, it may present a constriction at the level of Poupart's ligament. Thrill and bruit are distinct, and the latter may often be traced for a considerable distance along the femoral vessels. Pain is usually slight or absent in the deeper aneurisms, owing to the space available for the expansion of the tumour without interference with important structures; and hence the disease may reach an advanced stage, or the sac may even rupture, while the patient is still unconscious of its existence.

The condition mostly terminates by the bursting of the aneurism either internally or, more rarely, externally. In a recent case published by Mr. Gem, the hæmorrhage took place into the bladder (*Lancet*, Nov. 15, 1884). Gangrene of the limb has been recorded in one instance.

Diagnosis. — The characters of the aneurism are generally so well marked that little doubt can be entertained as to its nature. There are, however, two comparatively rare conditions which may be mistaken for the arterial disease—namely, pulsating tumour of the ilium and glandular or other growths in contact with the vessels.

Pulsating tumour of the ilium is distinguished from aneurism: (1) by the extent and position of the area of the growth, which is commonly traceable on the outer as well as on the inner surface of the bone, and external to the course of the arteries; (2) by the diffused character of the bruit, which spreads widely over the iliac fossa but does not extend along the course of the arteries of the thigh; (3) by the absence of the comparative enfeeblement of the femoral pulse observable on the affected side in the case of iliac aneurism; (4) by the possibility, in some instances, of tracing the pulsation of the artery by the side of the tumour.

A group of cancerous glands in the pelvis, compressing the three iliac arteries, has been known in one case, recorded by Mr. C. H. Moore, to cause symptoms so closely resembling those of iliac aneurism that the common iliac artery was ligatured, and the real condition was not discovered until the post-mortem examination (*Med. Chir. Trans.*, vol. xxxv.).

In rare cases, an aneurism of the abdominal aorta may descend into the iliac fossa even as low as the groin, as in an example reported by Letenneur. Arteriovenous aneurisms of the iliac fossa are extremely rare, only two cases having been narrated.

Treatment.—The cure of iliac aneurism has been attempted (1) by compression applied to the tumour itself or to the vessels above the point of disease; (2) by ligature, both distal and proximal; (3) by galvanopuncture; and (4) by injection of perchloride of iron.

1. *Compression.*—Owing to the position of the iliac arteries at the back of the false pelvis, the application of pressure, if long-continued, is less easily tolerated by the patient and is attended with more difficulty and danger, than in the case of compression of vessels in the extremities. The dangers attributed to the operation are those dependent upon the contusion of the peritoneum and viscera lying in front of the vessel. It has even been questioned by Mr. Holmes whether the measure is not more dangerous than ligature of the common iliac artery; but the statistics, for which we are indebted to the same authority (*see Lancet*, Oct. 10, 1874), do not lend countenance to this view. Of ten cases of compression for iliac and ilio-femoral aneurism, seven were cured. In the other three instances no beneficial effect was produced, and ligature was subsequently applied (in one case to the abdominal aorta) with fatal results, but the unfortunate termination does not appear to have been conduced to by the previous treatment.

The compression cannot usually be maintained for more than five or six hours, even with the aid of anæsthetics; but in one case it was applied for over ten hours, and was crowned with success just as the extreme limits of tolerance were reached. Direct compression of the aneurism by means of a bandage, associated with the application of ice, was tried in one case by Raynaud, in 1835, and effected a complete cure.

2. *Ligature.*—Iliac aneurism has been treated by proximal deligation of the external and common iliac arteries and of the abdominal aorta; by distal ligature; and by a modification of the operation of Antyllus.

(*a*) The external iliac artery has been tied many times for aneurism involving the lower part of this vessel and the upper part of the femoral artery. Of 141 examples of the operation collected by Rabe and Barwell (of which about three-fourths were for femoral aneurisms), 31 terminated fatally from various causes, including secondary hæmorrhage (15), gangrene, suppuration of sac, tetanus, pyæmia, &c.; but there is good reason to believe that this mortality would be largely diminished by the resources of modern surgery.

(β) Ligature of the common iliac artery was first employed for iliac aneurism by Valentine Mott in 1827, and has since been frequently practised, but with indifferent success. Of 36 cases collected by v. Kümmell, only 9 survived the effects of the operation, the rest (75 per cent.) dying from secondary hæmorrhage, peritonitis, pyæmia, gangrene of the limb, and other causes. To the list may now be added a successful case by Stetter. In one case recorded by Sands the patient recovered at the expense of the limb, which became gangrenous after the operation. The results so far are not very encouraging; but, as remarked by Mr. Holmes, there is little doubt that, in future, the procedure will be rendered less fatal by the use of antiseptics and drainage, and by the employment of animal ligatures.

(γ) Ligature of the abdominal aorta is an heroic measure that has hitherto been uniformly disastrous. It has been performed seven times, including one case of temporary deligation, the operators being Sir Astley Cooper, James, Murray, Monteiro, South, M'Guire, and Stokes. In the case of Monteiro, the patient did not die until the eleventh day after the operation, when he succumbed to hæmorrhage, which was afterwards found to proceed from an aperture in the artery above the ligature. This case, although ultimately a failure, may be regarded as a proof that the operation is not necessarily fatal. In M'Guire's case the left ureter was included in the loop.

(δ) Ligature on the distal side of the tumour has been performed four times, in all without success.

(ε) Ligature of the artery above and below the sac, followed by the deligation of the internal iliac, which appeared to communicate with the aneurism, was performed by Syme with a curative result, but the operation has not been repeated.

3. *Galvano-puncture* was tried by the writer in 1878 in a case of aneurism of the external and common iliac. The patient, a man aged 35, was the subject of mitral and aortic valvular disease. The tumour, fusiform in shape, and about the size of a large turkey's egg, extended downwards nearly as far as Poupart's ligament, and was in process of rapid development during the period of observation. After a fruitless and ill-borne attempt at compression, it was determined to essay galvano-puncture in preference to ligature of the common iliac, as there was reason to believe that the coats of that vessel were extensively diseased. Two needles, connected with the positive and negative poles of a Stöhrer's battery of twenty cells, were introduced into the lower part of the sac, and the current was maintained for three minutes, after which the needles were left *in situ* for forty-eight hours. No immediate effects were apparent, but at the end of the second day consolidation had evidently begun, and twenty-four hours later the impulse was almost imperceptible. At this time the patient unfortunately took advantage of the temporary absence of his attendant, and got out of bed to avoid the use of the pan; on the next morning the pulsation was again distinct, and shortly afterwards regained its original force.

In cases where the aneurism is superficial, especially in the ilio-femoral form, the use of galvano-puncture in association with compression would probably favour coagulation in a marked degree without adding sensibly to the risks of pressure. It is suggested that well-insulated gold or platinum needles, one or more in connection with each pole, be introduced into the centre of the tumour, and the needles, after the discontinuance of the current, left in place for forty-eight hours or longer, during which period the galvanism may be repeated if necessary. *See* ELECTROLYSIS.

4. *Injection of Perchloride of Iron.*—This measure was adopted in the case just cited, when the tumour was enlarging with such terrible rapidity that rupture appeared imminent. A drachm of diluted liq. ferri perchloridi (1 in 4) was injected into the lower part of the sac, while the common iliac and common femoral arteries were firmly compressed. On removal of the pressure thirty minutes after the operation, the aneurism was found completely consolidated. The limb was powerless, insensible to touch below the level of Scarpa's triangle, blanched, cold, and pulseless, but there were no constitutional effects beyond a slight and transient shock. The extremity remained in the same condition day after day; the temperature was reduced by several degrees, and no indications of returning circulation could be detected; nevertheless signs of gangrene were equally absent, and the health of the patient underwent steady improvement. The sac remained solid, but was rather hot and tender.

The patient was kept in absolute repose, with the limb slightly flexed and enveloped in a thick covering of cotton wool. At the end of ten days, the area of sensibility began to extend downwards, reaching nearly as low as the knee, an increase of the local temperature was perceptible, and the constitutional condition was more satisfactory than at any time since admission. On the evening of the sixteenth day, a sudden and apparently causeless change took place. The patient became suddenly collapsed, and rapid gangrene set in, spreading as high as the hip. The extremity was amputated at the hip-joint without loss of blood, and the scanty and imperfectly vitalised flaps were washed with a strong disinfectant solution. As a result, the patient rallied to a great extent from his prostration, and for a time appeared to struggle for life with some prospect of success; but his powers were insufficient to support the profuse drain which ensued at the seat of operation, and he died of exhaustion ten days after the removal of the limb. No autopsy was permitted.

The termination of this case was unfortunate, but the results of the two powerful measures were not wholly discouraging, especially when the extent of the arterial disease and the complication with a serious cardiac lesion are borne in mind. There is little doubt that had the patient observed the injunctions strictly impressed upon him after the galvano-puncture, a complete cure would have been achieved, as in a case of axillary aneurism that had been treated in the same manner a few months previously. The injection of perchloride of iron produced an immediate consolidation of the aneurism, and although the collateral circulation was gravely compromised, the limb maintained a hopeful struggle for existence until some accident, probably the occlusion of the chief of the still permeable channels by a detached fragment of clot, inflicted the *coup de grâce*.

Amputation at the hip-joint has not yet been suggested as a means of treatment in iliac aneurism, but the expedient is perhaps worthy of consideration, as an alternative for ligature of the abdominal aorta, in cases where deligation of the common iliac is ineligible. The removal of the lower extremity would permanently lessen the circulation through the diseased vessel, and would confer all the immediate advantages of the distal ligature. At the same time the danger of the operation would be small compared with that of the aortic ligature, while, in the event of a failure to secure the desired result, the internal iliac might be tied, and the more formidable measure of ligature of the aorta would remain open as a last resource.

William Anderson.

ILIAC ARTERIES. — The Common Iliac Artery extends from the bifurcation of the aorta at the left side of the fourth lumbar vertebra; the vessel then passes downwards and outwards across the fifth lumbar vertebra, until it reaches the sacro-iliac synchondrosis, where it divides into its terminal branches—the external and internal iliacs.

Each common iliac averages two inches in length, but may vary from three-quarters of an inch to three inches. There is but little difference between the lengths of the right and left artery. I. *In front of* the right artery are—the peritoneum; the ileum just about to enter the colon at the ileo-cæcal valve; the ureter crossing just at the arterial bifurcation; sympathetic cords on their way from the lumbar ganglia to the hypogastric plexus; the ovarian artery and vein in the female. *Behind*, are the meeting of the right and left common iliac veins, and the commencement of the inferior vena cava in front of the fifth lumbar vertebra. To the *outside* is the psoas muscle; the inferior vena cava emerges from behind it to appear on the right. To the *inside* is the interval between the two common iliacs, where the left common iliac vein crosses, the arteria sacra media descends, and the hypogastric plexus is found. II. The left artery has—in *front*, the peritoneum, the ureter, and sympathetic nerves, as on the right; but the sigmoid flexure crosses it to become the rectum, with the trunk of the superior hæmorrhoidal vessels. *Behind* are the fifth lumbar vertebra, and the left common iliac vein running to the inner side and on a plane posterior to that of the artery. The other relations are almost identical.

The External Iliac Artery extends from the sacro-iliac synchondrosis to Poupart's ligament. This vessel always presents a curve in the centre of its course, being the spot where the flexure of the vessels comes in the sitting posture; this is sometimes so pronounced that it arches down into the pelvis. In *front* of the vessel, both right and left, are—the peritoneum; the ureter at the commencement of the artery; the vas deferens at the lower end; the circumflex iliac vein crosses the artery beneath the vas deferens, and close to the giving off of the deep epigastric at

Poupart's ligament; the genito-crural nerve descends upon the artery. The right artery has the ileum crossing to become the colon, the left the sigmoid flexure to become the rectum. The psoas muscle is first to the *outer* side and then at Poupart's ligament *behind* either artery—i.e. the vessel lies on the psoas at the groin. The *vein* on the left side is to the *inner* side of the artery all the way along; the vein on the right side is, at and above Poupart's ligament, to the inner side of the artery, but it then crosses beneath it to reach the common iliac vein, to form the inferior vena cava.

The Internal Iliac Artery commences opposite the sacro-iliac synchondrosis on either side, and drops down into the pelvis in front of that articulation, until it reaches the upper border of the great sacro-sciatic foramen, where it divides into two primary branches—an anterior and posterior.

In *front* are the peritoneum, the ureter, and the first stage of the rectum on the left side; *behind*, the sacro-iliac synchondrosis, separated by the internal iliac vein. The external iliac vein also, on the left side, crosses behind it on its way to form the left common iliac. *Externally*, is the pelvic wall with the obturator nerve; *internally*, the rectum and the structures in the middle line. The vessel touches the edge of the psoas at its commencement, and at its ending the upper border of the pyriformis muscle.

Ligation of the External Iliac.—During the operation the patient lies in a recumbent position, with the shoulders raised so as to relax the abdominal muscles.

In choosing either a modification of Abernethy's or Cooper's operation the surgeon will be guided by circumstances; and when it is uncertain what artery requires ligature, will perform Abernethy's.

I. *Abernethy's Operation.*—The cutaneous incision on the right side is commenced at a point one inch above and one inch internal to the anterior superior spinous process of the ilium; from hence it is carried downwards and forwards in a curved direction, with the convexity downwards, for a distance of four inches. The incision ends half an inch external to a point midway between the anterior superior spinous process and the symphysis pubis, and three quarters of an inch above Poupart's ligament; on the left side the same incision is made, but in the reverse direction. The structures cut through are—skin; superficial fascia, with some branches of the superficial circumflex iliac artery; there may be much or little fat; deep layer of the superficial fascia—i.e. Scarpa's fascia; the aponeurosis of the external oblique is nicked and its fibres separated; the muscular fibres of the internal oblique and the transversalis muscles are cut through, and then, the transversalis fascia being exposed, nicked, and raised on a director (a hernial director is safest), the subperitoneal fat is reached. The fingers should be used to separate the tissues after the transversalis fascia is cut. By the fingers the peritoneum, with its contents, is pulled inwards until the vessel is well exposed. Retractors now hold the margins of the wound apart, the surgeon opens the sheath not lower than one inch above Poupart's ligament, draws the vein inwards, the genito-crural nerve outwards, and passes the aneurism-needle from the vein towards the psoas-muscle—i.e. from within outwards.

Dangers.—(1) Cutting too far inwards, and thereby wounding the deep epigastric; if this vessel be wounded, tie it. (2) Wounding the peritoneum by rash cutting, or by neglecting to use the director properly. (3) Failing to find the vessel in the usual position; if it is not normal, it will be found bent downwards towards the pelvis. (4) Wound of the circumflex iliac vein. (5) Including the genito-crural nerve, giving rise, according to observation, to tetanus. (6) The subsequent dangers are—gangrene of the lower limb, secondary hæmorrhage, sloughing of the sac, tetanus and peritonitis.

II. When it is known what the exact extent of the disease is and where the ligature is to be applied, Sir Astley Cooper's operation may be performed. Make an incision through the skin from just external to the external abdominal ring to near the anterior superior spinous process of the ilium. The incision will be about three inches long and parallel to the fibres of the external oblique muscle. Cut through the integument, fasciæ, and external oblique, slitting it parallel to its fibres. With the director separate the deeper tissues from Poupart's ligament, drawing the spermatic cord and epigastric artery upwards and inwards, and the internal oblique and transversalis muscles upwards and outwards. Tear through the transversalis fascia, when the peritoneum is raised by both the retractors and the vessel is seen and secured, as in the operation previously described.

Dangers.—(1) Finding that the disease is of greater extent than diagnosed, which, on account of the limited space given by the incision, makes it difficult to reach the sound artery. (2) Wounding the deep epigastric; this is to be immediately tied.

III. The so-called Esmarch's operation is practically a systematised Abernethy.

The Common Iliac Artery is ligatured by precisely the same incision as that employed in Abernethy's operation, only that the external limit of the incision given above is continued upwards towards the cartilages of the ribs for a distance of three inches. In other words, an incision is commenced just in front of the cartilage of the eleventh rib, and carried downwards and forwards to one inch and a half within the anterior superior spinous process of the ilium, and terminating by a sharp curve inwards just above the internal abdominal ring. The tissues cut through and retracted are the same as those met with in Abernethy's operation. The retraction of the tissues is continued until the pulsations of the external iliac can be felt, when the finger is run upwards, detaching the peritoneum, until the common trunk is reached. The needle is passed from within outwards on both sides.

Dangers.—Wounding the peritoneum, either when cutting down on the vessel or when it is being raised. To avoid wounding it open the transversalis fascia low down, where it is strongest, and, as the process of detachment is proceeding, gently but firmly support the parts, holding the peritoneum well out of the way. During the detachment the ureter clings to the peritoneum, and is pulled inwards with it. See also *External Iliac Artery* above.

The Internal Iliac Artery can be reached and ligatured by steps identical with those employed for the common iliac. Steven of Santa Cruz, however, who first tied the vessel, reached it by making an incision five inches long and half-an-inch outside of, and parallel to, the deep epigastric artery. Another incision has been employed, but with many evident disadvantages; it is an incision practised by White, commencing two inches to either the right or left of the umbilicus, according to the side required, and cutting downwards and inwards by a curved incision, with its convexity towards the ilium, and ending just above the external abdominal ring. James Cantlie.

IMMOBILITY, or absolute rest, is one of the most potent factors in the healing process of bruised or broken, diseased or wounded, hard or soft tissues. As a therapeutic principle, immobility underlies the whole surgical domain. It is one of the fundamental and most generally applicable lessons of physiological surgery, and one of the chief aims of surgical handicraft and mechanics; especially so in the treatment of wounds, sprains, and fractures, and of articular diseases. Repair is in direct proportion to rest; and the nearer this approaches to immobility, the more perfect will be the work of reparative surgery. Physiological position and equable pressure powerfully contribute to immobility; but, as a rule, this cannot be secured without mechanical contrivances. Of these, the best and most generally useful are moulds and splints, enclosing the joints above and below the point to be immobolised, sand, shot, and water-bags, weights, pulleys, and swings. For the construction of moulds, a great variety of materials are available —millboard, gutta-percha, paraffine, and poro-plastic felt, starch, dextrine, silicate of potash, plaster of Paris, and strips or sheets of wood and metal. The surgeon's choice must be regulated by the exigencies of particular cases, and by his opportunities of acquiring experience with different kinds of materials and methods. Wire moulds are easy of construction, and may be made strong, yet light. Another simple and efficient plan for immobilising a limb, or the trunk, consists in padding well, and then adding diagonal strips of moistened millboard or plastic felt, thin metal or deal veneer or scaleboard. Bandaging, lightly yet firmly, smoothly and without reverses, commences when the first strip is laid on. Successive strips and layers of bandage follow, until a perfectly fitting and comfortable mould is constructed, with all the strength possessed by alternately intersecting spirals. The addition of gum, starch, chalk, or other solidifiable material, over the layers of the apparatus in process of construction, materially contributes to its strength. Rigid splints and moulds, however constructed, may often be usefully combined with undulating suspension, in securing immobility; illustrating how in the treatment, as in the production, of injuries and diseases, a combination of causes, seemingly, but not essentially, different, may contribute to common ends. *See* Position; Pressure; Rest; Suspension.

Sampson Gamgee.

IMMOBILISATION. *See* Immobility.

IMMOVABLE BANDAGES.—The essential principle in all the substances used for immovable bandages is, that they can be applied in such a soft and pliant state as to be accurately adapted to the shape of the part, and that, when they have set, they form a firm and even support for every portion of it. The most important materials used are bandages soaked in starch, dextrine, plaster of Paris, a mixture of gum and chalk, glue, silicate of potash or soda, paraffin or bees' wax; coarse flannel soaked in plaster of Paris; gutta-percha, leather, and poro-plastic felt. They are used to maintain accurate position and immobility of broken bones and excised joints, to secure perfect rest of diseased joints, to make spinal supports, to rectify deformities of joints, &c., and to fix interrupted metal splints in compound fractures, excisions, &c.

Some form of immovable apparatus is usually employed as a final support to fractures, but opinions differ with regard to their immediate treatment in this way; the only valid objection to it appears to be the danger of the limb swelling and causing localised sloughs or gangrene; but if the patient be watched for a few days, there need be no alarm on this score, for any swelling and blueness of the toes, or pain from the apparatus, should lead to its instant removal and the relief of pressure. There are, moreover, a number of advantages resulting from this method of treatment; perfect immobility is secured at once, so that pain and laceration of tissues resulting from muscular spasm are prevented, and the bones are placed in the most perfect condition for rapid union; the apparatus is so comfortable that it is unusual to have complaints of uneasiness, even from fidgety patients; the irksomeness of a fixed position is obviated, for the patient is able to turn about when the apparatus is set, and in the course of a few days he is able to get up and out into the open air; his stay in hospital is much diminished, and, if his occupation is suitable, he is very quickly enabled to attend to it in some degree.

Plaster of Paris Bandages.—The finest plaster, such as dentists and modellers use, is required; it must be freshly prepared, for any dampness will interfere with its 'setting;' and, if there is any doubt about its condition, it should be baked in an oven, so that it may be again rendered fit for use. The best bandages for this purpose are made of crinoline, the meshes of which are sufficiently large to allow of the plaster being well ground into them, but not large enough to let it fall through; it is very important that the plaster be well ground into the meshes, and that any superfluous powder be rubbed off, for if left it makes the bandage lumpy. The bandages should be rolled up loosely, and if not used all at once they should be placed in an airtight box, or they will quickly spoil. If there be no fear of swelling, the limb should be first covered with a flannel bandage; but if swelling be expected, as in a case of recent fracture, cotton wadding should be used by preference, as that will yield a little in the event of swelling occurring, whilst at the same time it exercises an elastic pressure on the limb, and also expands again as the swelling subsides. Place a bandage on end in a basin of warm water till it is saturated and all bubbles have ceased to rise, then squeeze out the superfluous water, and apply the bandage by spiral and oblique turns, rapidly ascending and descending the limb, till the whole is covered in. The oblique turns have the advantage that they lie quite evenly, without reverses, and run more nearly in the length of the limb, and so ensure greater strength and less liability to transverse cracking of the apparatus. While one bandage is being applied, another should be placed in the water to soak; as a rule, three or four thicknesses of bandage will suffice; reverses should not be used, but the final layer may be put on by figure-of-eight turns, so as to give a neat appearance to the splint. The whole apparatus may be smoothed over with plaster-cream, but the folds of the bandage should not be effaced by it. If greater strength be required, strips of wood or perforated tin may be placed between the layers of the bandage. If a window be required, the situation should be indicated by some contrivance, and a good one is to take a piece of card of the requisite size, prick a pin through the centre of it, and place it, with the pin projecting outwards, over the required spot, and as the bandages are rolled over that part, make the pin pass through them and stand off from the surface, as an indication of the centre of the area to be cut out from the plaster case.

Bavarian Splint.—Take two pieces of flannel, long enough to reach from the ham to the ball of the toes, and a few inches wider than the circumference of the leg, stitch them together along the middle line for the length of the leg, and beyond this cut them through in the same line; put the flannel behind the limb, with the seam exactly in the middle, bring the inner layer round and pin it along the front of the leg, the dorsum and sole of the foot, so as to form a tightly-fitting stocking; smear this layer all over with plaster of Paris cream, and before it sets, press the outer layer, already cut to the proper size, evenly over it. When the plaster has set, remove the pins from the inner layer of flannel, and bring the borders of the latter round the edge of the splint in front and along the sole, and stitch it to the outer layer. The apparatus forms an accurately-fitting splint, which can be easily removed without in any way disarranging the limb, as the seam along the back of it acts as a perfect hinge.

Croft's Splint, for the immediate treatment of fractures of the leg, consists essentially of two well-moulded lateral splints, made of coarse house-flannel, thoroughly soaked in plaster of Paris cream; the flannel should be thoroughly shrunk, and from it four pieces, having the shape of the patient's stocking, and long enough to reach from just above or just below the knee to the middle of the metatarsus, should be cut, particular care being taken that the foot-piece is at right angles to the leg-piece, and also that the anterior border of the latter is a straight line. Arrange the four pieces of flannel in pairs—two for each side of the leg—and saturate the outer piece of each with plaster a little thicker than cream, and re-apply it to its fellow. The splints ready, the patient should be anæsthetised if necessary, the leg 'set,' and held in position with the foot at right angles to the leg, the splints applied and fixed by simple plaster of Paris bandage. The apparatus may be easily cut down the front, if need be, the edges trimmed, and the splint eased or tightened as required. If a window be needed, it should be cut in the flannel before it is soaked in the plaster of Paris cream.

Starch Bandages are used for similar purposes to plaster of Paris ones, over which they have the advantage of lightness, but the disadvantages of requiring a longer time to dry, and of not forming so strong a support. Prepare a bowl of hot 'clear starch,' and pass well-shrunk calico bandages through it, and re-roll them; next envelope the limb evenly with a layer of cotton wadding, and smear the latter with starch; then take pasteboard splints, which have been torn to the requisite size and shape, steep them in boiling water and then in starch, and whilst still hot, apply them to the limb outside the cotton wool, and fix them in position by a turn of bandage here and there. Let the limb be held in position, and then apply the starch bandages, and, as they are rolled, let more starch be rubbed into them by hand, or painted on with a brush; reverses should be avoided, as they cause uneven pressure, and add considerably to the difficulty of cutting up the bandages. When dry, the starch apparatus is often too loose, and if so, it should be cut up the front, and the edges pared and brought close together by another starch bandage.

Paraffin forms a light, non-absorbent splint, and has the advantage that it can be recovered from an old splint by steeping it in boiling water, when the paraffin will rise to the top and solidify there as the water cools. The paraffin should melt at from 120°–130° F. To make a splint of it, bandage the limb with a flannel roller, and over it apply a few layers of strips of flannel soaked in the molten paraffin. It is best to put on the paraffin in strips, like strapping, as it sets too quickly to be applied in a continuous bandage. Macewen's method is perhaps still better, and easier of application; he takes a piece of sheet cotton-wool, cut so as to ensheath the limb accurately, and steeps it in melted paraffin; he then applies a gauze bandage to the limb, adjusts the paraffin splint, and puts another gauze bandage rather firmly outside all.

Silica, or Liquid Glass, Bandages may be kept ready for use in bottles of the silicate solution. They 'set' sufficiently to restrain movement in less than an hour, but require two or three days to harden completely; they can be easily removed, as the silicate is soluble in water.

Gum-and-Chalk Bandages are applied in the same manner as the starched ones, over which they have the advantage of 'setting' more quickly, and forming a firmer splint; equal parts of gum arabic and precipitated chalk should be mixed up with boiling water, and the bandages passed through the mixture and re-rolled; gauze bandages do very well.

Glue Bandages form a firm and elastic splint, which can be easily cut up about twelve hours after application, and the edges fitted with 'eyelets' if required. Steep some fragments of the best French glue in cold water for a few hours, then melt it in the usual way, and add one-fifth part of methylated spirit, stirring the mixture well, so as to cause solution of the coagulum formed on the addition of the spirit; the spirit accelerates the hardening of the glue. Cotton bandages should be used and, as each one is applied, it should be thoroughly brushed over with glue; two or three layers of the bandage are usually sufficient.

Bilton Pollard.

IMPACTED CALCULUS. *See* Stone in the Urethra.

IMPACTED FRACTURE. *See* Fractures.

IMPETIGO (*Synon.* Impetigo contagiosa; Porrigo contagiosa).—The name impetigo was formerly applied to certain diseases of the skin attended with the formation of *pustules;* thus an eczema in which pustules were abundant was called impetigo. The pathological change seemed to the older writers to entitle the disease to a change of name, and the fact that pus-formation is only part of a *morbid process* which may occur in almost any inflammatory disease of the skin was apparently overlooked. In the sense above indicated, the name impetigo does not convey any very clear idea of a definite disease distinct from eczema, and therefore the name pustular eczema is to be preferred. Dr. Duhring, of Philadelphia, is the only writer of mark who describes, under the name impetigo, 'one of the rarer skin diseases' distinct from impetigo contagiosa and eczema, and says 'the initial lesion is a perfect pustule.' The writer of the present article has failed to identify Dr. Duhring's impetigo with any disease met with in England; indeed, it may be doubted whether the 'initial lesion' in any disease can be a 'perfect pustule.' The late Dr. Tilbury Fox drew a distinction between common porrigo and impetigo contagiosa; but the distinction, if any, is one of cause rather than of kind. German writers of the Vienna school, on the other hand, scarcely admit any form of impetigo as distinct from eczema; the distinction is, however, fully recognised by most American, English, and Continental writers, and is certainly convenient. The name impetigo is gradually and rightly displacing such terms as porrigo and impetigo contagiosa, which might with advantage be dropped out of our nomenclature.

Impetigo is an inflammatory affection of the skin, attended with a vesico-pustular eruption. The vesicles are usually isolated or scattered in small groups; their contents very quickly become puriform, and this is followed by rupture of their walls and the formation of thick, light yellow scabs, which completely cover an excoriated surface; the eruption is very easily reproduced by inoculation.

Impetigo is a disease which has given rise to much discussion. Many writers on the subject appear to lose sight of the fact that all pus, under certain favourable conditions, is capable of being inoculated with the result of producing more pus. The fact, that the pus of impetigo is usually more readily inoculated than other pus, depends on the surrounding influences of the case; unfavourable hygienic conditions are enough to explain the difficulty which seems still to puzzle some writers. The disease, though occasionally introduced into the schools and families of the well-to-do classes, never spreads rapidly, while amongst the crowded poor of our large towns it quickly attacks every young member of the household.

Etiology and Pathology.—The causes of impetigo are almost always local, combined with unfavourable hygiene. That the latter is an important factor is proved by the fact that the disease is almost confined to the poor, dirty, and badly-fed classes; the local cause is *pus-inoculation*, the origins of which are very numerous. Amongst the best recognised may be mentioned superficial whitlows, burns, vaccination or any slight wound that 'gathers' or 'festers,' as non-professional people are in the habit of calling the formation of pus. But by far the most common cause is pediculi capitis: here the lesions from scratching are numerous, and the pus is very easily transferred by the nails to other parts of the body, especially to the nose and corners of the mouth. In all cases the pus is quickly absorbed by the lymphatics, hence the rapid enlargement of the glands of the neck. This absorption by the lymphatics plays, in the opinion of the writer, an important part in the extension of the disease, as it does not seem possible to explain the very rapid and extensive eruption of pustules, which sometimes occurs, on the supposition that each pustule is the centre of a separate inoculation. The constitutional disturbance which often accompanies the disease also seems to point in the same direction.

Diagnosis.—The following points will especially distinguish impetigo from ordinary eczema:—(1) Each spot appears as a single vesicle or small group of vesicles, without the surrounding skin being red and inflamed, very unlike the first appearance of a patch of eczema; (2) it is easily inoculated; (3) it is usually unsymmetrical and more distinctly a local affection than eczema; (4) it is unattended with itching unless complicated with pediculi or eczema; (5) it is almost entirely a disease of the poor and dirty classes, and chiefly confined to children; (6) the children who suffer long from it are always pale and badly nourished; (7) pediculi capitis being the most common cause, it follows that the occiput is the most common primary seat of the disease; it is thence transferred to the nose and corners of the mouth and to other parts of the body, or from person to person; (8) when the occiput is affected the glands in the neck are quickly enlarged.

Treatment.—Impetigo of the scalp is quickly cured by white precipitate ointment, which heals the sores and at the same time removes the cause. On the body, the best local application is a thick lotion made of calamine, zinc oxide, and lime water; this should be painted on with a brush and allowed to dry on, so that a crust is formed. If pus collects under this crust, it should be removed and the excoriated surface painted again with the lotion; when the crusts remain firmly attached the cure is soon effected. Tonics, especially iron, are useful. Robert Liveing.

IMPOTENCE.—Incapacity for sexual intercourse must be distinguished from sterility, or incapacity for the secretion or ejaculation, at the requisite time, of normal seminal fluid. The subject of sterility is not necessarily impotent; but if we except the rare cases in which conception has occurred without penetration, impotence involves sterility.

Impotence may be congenital or acquired, complete or partial, permanent or temporary, and may result from widely different causes.

Enlargement of the scrotum, from a large irreducible scrotal hernia, or from a large hydrocele of the tunica vaginalis, or from elephantiasis, may prevent copulation. Malformation of the penis, such as extreme epi- or hypospadias, arrest of growth of the external genitals, so that they remain of infantile size in adult life, benign or malignant growths on the penis, may also prevent it. Inflammation or suppuration of part of the corpus spongiosum, or of the corpora cavernosa, sometimes results in the formation of cicatricial tissue, by which the penis may be so distorted during erection as to render penetration impossible. Induration and contraction of the frenum may have a similar result. Total loss of the penis from accident or disease necessarily causes impotence, but partial removal of the organ has not this effect, if enough be left to allow of penetration. Arrest of development of the testicles, or complete destruction of both glands from accident or disease, will usually be attended with impotence. In some cases, however, of double castration, the power of copulation has been retained for some time after the operation. Partial or complete defect of the erectile power from some abnormal condition of the central nervous system is the most usual cause of impotence. Erection is the result of a greatly increased supply of arterial blood through the temporarily dilated afferent vessels of the penis, combined with retarded outflow from the organ, in consequence of relaxation of the muscular fibres in its cavernous structures, and possibly of compression of the dorsal vein by fibres of the accelerator urinæ muscle. The process is controlled and regulated by nerves originating in ganglion cells, the so-called erection centre, in the lumbar portion of the spinal cord. This centre can be excited by peripheral stimulation of the afferent nerves of the genital organs, and possibly by the quantity and quality of the blood supplied to it. It is also connected, by fibres in the spinal cord, with higher centres in the cord itself and in the cerebrum, by which it can be excited or inhibited. These centres, with their connecting fibres, and afferent and efferent nerves, form a complex nervous system, and impotence from defect of erection, may result from disturbance of the due relation between the several parts of this system, or from injury, disease, or degeneration of it.

Impotence from the condition of the central nervous system may be classified as psychical, irritable, and paralytic.

Psychical impotence results from undue predominance of the cerebral inhibiting centres, so that erection does not occur. It is, in most cases, of only temporary duration. Newly-married men sometimes find themselves incapacitated from performing marital functions from this cause. In those who have led chaste lives, it may be due to nervousness or great excitement. But in cases where excessive venery or masturbation has been practised, the predominant inhibition may be due to diminished excitability of the lumbar centre. Patience, and the assurance that there is no physical incapacity, generally suffice to terminate this unpleasant condition. This form of impotence is sometimes more persistent, but is limited to attempted connection with one individual, and is not experienced with others. Such cases are very rare; but the story told by Herodotus of King Amasis and his wife Ladike, is corroborated by more modern apparently genuine instances. The inhibition in these cases is probably reflex, and excited by some peculiarity in the female.

In irritable impotence there is erection, but of very brief duration, and the semen is ejaculated before penetration has been effected. There may be varying degrees, and some cases are on the border line between impotence and sterility. It is due to over-excitability of the nervous centres, and generally results from habitual masturbation or excessive venery.

Paralytic impotence may be due to injury, disease, or degeneration of the nervous centres. Blows upon the head, or injuries to the back, are sometimes the cause of permanent or temporary impotence, which can only be explained by the assumption of some affection of the nervous system. Fracture of the spine, producing paraplegia, must necessarily cause impotence. If the injury to the cord be above the lumbar centre, there is usually persistent priapism, from hyperæmia or irritation of the lumbar centre, or from accidental peripheral stimulation in the absence of all inhibiting control. But even if there be no priapism, reflex erection could doubtless be produced in such cases if the lumbar centre be intact, and cases are recorded where, despite the paraplegia, copulation, and even procreation, have been effected, the man being, of course, passive in the transaction. Diseases of the cerebrum and spinal cord may also cause impotence, which is sometimes an early symptom in locomotor ataxy.

Cases not infrequently occur of premature diminution, and ultimately of total loss of virility, without any symptom of disease or history of injury. These can only be explained by the assumption of premature degeneration of the nervous centres. The duration of sexual life is very variable, in some being prolonged to extreme old age, in others terminating at a much earlier period. The latter may be due to individual idiosyncrasy, but is more frequently the result of premature and excessive indulgence in venery, or of habitual masturbation. Impotence may be a symptom of general exhaustion, temporary after acute fevers, or permanent in wasting diseases, such as phthisis. It is often associated with Bright's disease, and, in varying degrees, with diabetes. Gout may induce it temporarily, and it is often the result of disordered digestion, especially if there be oxaluria or phosphuria.

Lastly, certain drugs are credited with producing impotence. Arsenic, according to Charcot, has this effect when taken for a long time, but on the cessation of its use virility is regained. Opium-eating and excessive indulgence in tobacco are also said to produce impotence, probably from their deleterious influence on the nervous and digestive systems. Considering the prevalent use of tobacco without such results, there may possibly have been some special susceptibility to its influence in the cases where this effect has been observed.

The prognosis with respect to impotence must depend upon the cause, which can be ascertained only by careful inquiry into the history and general condition of the patient.

Treatment.—This will vary with the cause. When impotence is a symptom of some other disease, the appropriate treatment for the exciting cause must be pursued. Impotence from mechanical hindrance, such as hernia, hydrocele, benign tumours, or growths, cicatrices, and the like, may in some cases be relieved by operative interference.

Psychical impotence, as a rule, requires only moral treatment. In irritable impotence, due to previous excess, complete chastity of mind and body for a time, cold bathing, and suitable tonics, will be of great service. Easton's syrup of phosphate of iron, quinine, and strychnia, is a very useful preparation in these cases. Electricity has been highly commended, and the frequent application of a constant current to the lower part of the spine may be of service in reducing the over-excitability of the lumbar centre. In persons of naturally feeble power, so-called aphrodisiacs, such as phosphorus and the tincture of cantharides, are sometimes useful; but in cases of exhaustion from excess they are of as little service as would be the spurring a jaded horse when a long journey has still to be performed. In impotence from injury to the head or back, blisters along the spine have been recommended; but the treatment is so empirical and uncertain in its results, that it is difficult to estimate in the successful cases how much may have been due to art, how much to nature. Premature loss of virility, with retained sexual desire, is especially troublesome. Such patients are usually hypochondriacal, and sometimes develop suicidal tendencies. They appear to regard copulation as the only purpose of existence, and to have lost, with the ability to accomplish it, all inducement for living. Even in these cases, chastity of thought, exercise, cold bathing, and nervine tonics may effect some improvement. But the prognosis is not favourable, and the happiest result would be if they could be induced to adopt Cicero's philosophy, and regard their loss as gain. 'O præclarum munus ætatis, si quidem id aufert, quod vitiosissimum adolescentiæ est!'

Jeremiah McCarthy.

INCARCERATED HERNIA. *See* Hernia, Obstructed.

INCLINED PLANES are appliances by means of which broken limbs may be supported, and displacement of the bones prevented by relaxing the faulty muscles. The single inclined plane supports the lower limb with the knee extended and the hip flexed, and this has been recommended in treating fractures of the patella; it is also useful to support the limb when the venous circulation in it is impeded. The double inclined plane is so adapted as to support the lower limb with the knee and hip-joints both flexed, which position relaxes the psoas and iliacus, and prevents their traction on the upper fragment in fractures of the femur high up; it also relaxes the hamstrings and the calf-muscles, and so removes much of the cause of displacement in fractures close to the lower end of the femur. The apparatuses, to which the term inclined plane is primarily applied, are made of wood; some of them are made with fixed angles, but others have arrangements by which the angles may be altered. As a rule there are no lateral supports, but Esmarch's inclined plane is perforated by a number of holes into which pegs may be placed; when the limb is in position on the inclined plane, pegs are placed in the most suitable holes to form a barricade all along the limb, and so prevent it from slipping from its position.

McIntyre's splint and Hodgen's suspension splint are essentially inclined planes, and are more comfortable than the wooden ones above described. Bilton Pollard.

INCONTINENCE OF URINE, or ENURESIS.—In this affection the will cannot control the action of the bladder, and urine is involuntarily discharged, greatly to the annoyance of the patient, and often seriously affecting the performance of his or her social duties. In these cases the bladder is always empty, or is periodically emptied by the involuntary efforts of the patient. There is, however, a condition known as false incontinence, which it is of great clinical importance to distinguish from the true variety; here the bladder is never really emptied but is habitually full of urine, while the overflow runs off and makes the bladder appear incapable of holding any water. Such cases are at once distinguished by the use of a catheter, when the chronically retained urine is drawn off. False incontinence results from long-standing urethral stricture, chronic enlargement and other affections of the prostate, and from atony and paralysis of the bladder. In women, in addition to atony and paralysis of the bladder, its expulsive power may be seriously interfered with by certain conditions of the uterus, notably, by prolapse and retroflexion of that organ. For the treatment of false incontinence *see* Bladder, Diseases of the.

Men, women, and children may all suffer from true incontinence of urine. In men and women, true incontinence may result from defect in the primary nervous centres. When this is so, probably other organs will be affected besides the bladder. Here the surgeon can do but little. The treatment must consist of tonics and stimulants, diet, sea bathing, and the use of electricity. Vesical calculus may be the cause of constant dribbling of urine; in which case the stone is usually lodged in the neck of the bladder. In the same way prostatic calculus may cause incontinence. There is a peculiar form of chronic enlargement of the prostate, where the hypertrophy so affects the neck of the bladder that its action is rendered imperfect and urine constantly flows away, although there is absolutely no habitually retained water. Here the patient must wear an india-rubber convenience, and beyond careful attention to the bowels there is nothing to be done; fortunately such cases are of extreme rarity. At all ages, and in both sexes, incontinence may follow severe injury to the urinary apparatus, the result of kicks, falls, or tubercular or syphilitic ulceration.

Incontinence of urine, in women, may be caused by injury to the neck of the bladder or urethra, from the prolonged pressure of the child's head during labour, or from the use of instruments; and also from operations undertaken for the removal of stone from the bladder. In certain of these cases, plastic operations may be undertaken with some hope of success. After perineal lithotomy both men and boys occasionally suffer from incontinence. In children this unfortunate condition appears to come on quite independently of the size of the stone or of the roughness of the operation; but in men it appears to have some connection with the size of the stone, and the writer has known it follow the operation of lithotomy, when the wound has required firm and prolonged plugging on account of hæmorrhage. In these cases, during the night there is usually (except in children) no escape of urine, but in the daytime there is a constant leakage, the patient also making urine naturally at regular intervals. An india-rubber receptacle may be worn, or a napkin only if the escape be very slight. An attempt may be made, but it is rarely successful, to retain the urine by means of the pressure of a perineal pad, secured by a truss, or by elastic shoulder-straps or braces.

Juvenile Incontinence.—In children there is a special form of urinary incontinence, which deserves particular attention. The bladder appears to be in a hyperæsthetic condition, and children of all ages and of both sexes may pass urine involuntarily during the night and day. Usually it is in the night only, and the child wets his bed and is said to suffer from nocturnal incontinence of urine. During babyhood the habit often escapes notice, or is looked upon as almost natural, but as age advances the debility is found very distressing, and sooner or later medical aid is called in; especially when the parent finds that the child is debarred from many educational and social advantages. Generally, there is nothing remarkable about the appearance of these children, although often they are exceptionally bright and intelligent. Sometimes, the habit has resulted from neglect on the part of the mother or nurse, who has omitted to rouse the child during the many hours it is naturally in bed. In other cases the affection arises from the local irritation of intestinal worms, from a tight, long, and perhaps adherent prepuce, or from a too acid or other morbid condition of the urine. In most cases, however, it is simply a nervous debility, either the expelling muscles of the bladder are unduly active or the retaining muscles are weak, or there is a want of proper co-ordination between the two sets of muscles. As puberty arrives the weakness usually, but not always, disappears.

Treatment.—In the first place see the child make water, and note if there is pain or difficulty in the act of micturition. Be on the look-out for symptoms of stone, and even for retention of urine; the latter may be suspected if there is a suprapubic tumour, the former if the incontinence is diurnal, and if there is much pain at the end of passing water; but, if all appears to be right, do not distress the child with the use of any urethral instrument. In treating the children of well-to-do parents, remember that it is very unusual for them to suffer from vesical calculus. Next, examine the urine, look for albumen, sugar, pus, blood, and for lithates, as well as earthy phosphates. Very likely the urine will be quite healthy. Inquire if red sand is ever noticed in the child's water. Inquire also about worms: ask if any have been seen, and if any anal itching is complained of. Examine the foreskin; if it is not easily retractable, perform circumcision. This operation is universally desirable, and, should the incontinence persist afterwards, the child will in every way be in a more advantageous condition than he was before. If worms are present (usually thread-worms), remove them by means of common salt enemata and vermifuge medicine, such as santonin, followed by a brisk purge. If the urine is habitually too acid, attention must be paid to diet, and a small dose of grey powder given; afterwards a little alkaline medicine may be administered, but all diuretic salts must be carefully avoided.

In all cases the diet must be regulated. The meals should consist of breakfast, dinner in the middle of the day, and supper. All stimulants, including tea and coffee, must be absolutely interdicted. No sweetmeats are allowable, and certainly not much butcher's meat. Some have advised entire abstinence from meat and even from broths, but this does not appear to be necessary. The child should live upon bread, vegetables, fruit (in moderation), milk, any farinaceous foods, butter, eggs, fish, fresh game, poultry, and a little meat. An effort should be made towards evening to curtail or even to avoid all fluids. The general habits of the child must also be superintended. He should be warmly clothed, and the skin kept active by plenty of hot water, soap, and good rubbing. His life should be a quiet one, all excitement such as is afforded by theatres and children's parties, is to be avoided, and in many cases a diminution of the school tasks will be advantageous. In rare cases, the child may be allowed to run wild in the country or at the seaside for twelve months. All terrorism is wrong, and parents, nurses, or schoolmasters using the rod in such cases deserve a hundred times the punishment themselves. The young patient should go to bed early, and should be taken up the last thing at night and early in the morning to pass water. In the daytime he should be encouraged to hold his urine as long as possible, and at night his bed should be a hard one, and the coverings not very heavy. He should sleep on his side, and not on the back; this is often managed by tying a knotted handkerchief round the waist, with the hard central knot just over the middle of the back. The bowels must if necessary be made to act daily, easily and gently.

It is surprising how much may be done by careful management, but in many cases medicines must be resorted to. The drug most in favour, and which undoubtedly is frequently successful, is belladonna and its alkaloid, atropine. The tincture of belladonna and the extract are both used. Care should be taken that the drug is of the very best quality. It acts by partially paralysing the bladder. A small dose should be commenced with, three times a day, and gradually increased, while its effects are closely watched, so that directly any symptoms of excess are seen, such as dryness of throat and dimness of vision, its increased administration may be stayed. When the bladder is found to be controlled by this medicine, the dose is not to be further augmented, but the patient should be kept under its full influence about a week, and then the doses may be gradually diminished until the medicine is entirely left off. In the same category come the ordinary preparations of opium administered by mouth or rectum, and also chloral hydrate and the bromides. The writer has used codeia with satisfaction. These medicines act by diminishing sensibility, and enable the bladder to become tolerant of urine. On the other hand, in some cases stimulants and tonics are useful; all the ferruginous preparations, together with strychnia, cantharides, and ergot, have been largely used. It is almost needless to say that any condition of the general health requiring cod-liver oil or other special medicines must be attended to. Counter-irritation is sometimes of service. This is usually made by applying a large blister over the sacrum. The blister may be kept open by dressing it daily with savin ointment. Doubtless counter-irritation is often useful, and it is advantageous also in an indirect way, for, if applied over the sacrum, the sore place prevents the patient from sleeping on his back.

In boys the passage of a soft bougie is often beneficial, and in both sexes as a last resource a mild solution of nitrate of silver may be applied to the urethra. In boys this is done through a small catheter passed into the deep urethra. The solution at first should not be stronger than two grains to the ounce of water, afterwards the strength may be gradually increased up to eight or even ten grains. All mechanical methods of closing the urethra, by means of collodion, elastic ligatures, &c., are not recommended. In conclusion, it may be remarked that these cases are often very obstinate, and unless there is strict attention to details in the treatment, it had better not even be attempted, so far as the credit of the practitioner is concerned.

G. Buckston Browne.

INDURATION, in the majority of cases, is the sequel of inflammation. It then varies directly as the chronicity and inversely as the activity of the exudation. But the constitutional state of the patient and the intrinsic nature of the disease are very important factors in fashioning the final result. In strumous enlargement of the lymphatic glands, the degree and distribution of the induration change with the sequence of phases of the morbid process. At first the hardening is diffused, then it gives way, in the centre of the gland, to the softening of suppuration or caseation, whilst finally, the pultaceous débris not seldom becomes impregnated with lime salts, and a nodule of chalky or stony density, surrounded by close-grained cicatricial tissue, is the abiding mark of the previous disease.

Again, there are some maladies, mostly of a specific nature, like syphilis, diphtheritic croup, and croupous pneumonia, in which the exudation is highly fibrinous. The comparative induration of different venereal sores is a valuable aid to their diagnosis. It is not alone in the primary lesion of syphilis that the induration is so marked. The same holds good as regards the swelling of the lymphatic glands—indolent bubo.

Induration is one of the changes incidental to old age: thus the cranial bones become thicker and more compact from ossific deposit, and the parenchymatous organs—e.g. the brain—are subject to overgrowth of interstitial tissue. The terms *sclerosis*, *fibrosis*, and *cirrhosis* are employed to indicate indurating processes, which in former times were considered as inflammatory, but are now regarded as simple fibroid substitution—a distinction almost without a difference. Familiar examples are furnished by the so-called 'gin-drinker's liver' and by the sclerotic lesions of the spinal cord—posterior, lateral, annular, insular, &c.

It may be stated generally that the firmer the tissue in its natural state, the greater is the induration of disease: take, e.g., epithelioma of the skin, lip, or tongue, and a periosteal node in which ossification of the inflammatory neoplasia is a frequent event.

The condition known as *solid œdema* follows diffuse thrombosis of the veins and blocking of the lymph paths. It is slow to disappear, and in marked cases, where many vessels are obliterated by organised clots, there is permanent induration and enlargement of the part. The resistance to pressure in phlegmasia alba dolens may be compared with the easy pitting in serous œdema from renal or cardiac disease.

The degree of the induration aids, as before said, in the differential diagnosis of venereal sores. It is likewise called into requisition when a doubt exists as to the cancerous or syphilitic nature of an ulcer of the tongue. In each there is hardness due to inflammation, but in cancer there is added that from cornification of the epithelial cells. A periosteal node is simulated by erythema nodosum, but the former is much the harder of the two.

Again, a localised indurated swelling in the breast may be a scirrhus, an adenofibroma, or a chronic abscess. Apart from other considerations, the greater the induration the stronger is the probability of its being malignant. The author's experience, however, leads him to the conclusion that too great a value is given to this sign in the diagnosis of mammary tumours.

Treatment.—Very little can be done for non-inflammatory induration, and the more chronic the latter the less is the chance of success. The indications for treatment are—(1) to remove the cause; (2) to administer absorbents, such as mercury and iodide of potassium; (3) to apply well-directed continuous pressure.

In the limbs a Martin's bandage will do good service. For enlarged indurated glands in the neck the patient should be directed to lie down for a few hours each day, with a bag containing from two to six ounces of shot placed over the swelling.

Augustus J. Pepper.

INFARCT. *See* Embolism.

INFLAMMATION.—The process of inflammation may be defined as the succession of changes which occur in a living tissue when it is injured, provided that the injury is not so severe as at once to destroy its structure and vitality; the extent of these changes depending on the length of time and the energy with which the cause acts. For experimental purposes inflammation is usually induced by the application of an irritant; and if we look at a part under the microscope in which inflammation has been set up in this way, two sets of phenomena are witnessed—the earlier, which appear to have their seat in the blood-vessels, and the later, in which changes in the tissue are most marked.

In looking at the early phenomena of inflammation we have to remark two things—viz. disorder of the circulation and transudation of certain of the contents of the blood-vessels. Before proceeding to consider these, it will be well to recall some of the facts with regard to the normal circulation, especially as witnessed in the web of the frog's foot. On looking at the normal circulation in the frog's web, one sees the arteries, veins, and capillaries, the arteries being considerably smaller than the accompanying veins, and constantly varying in calibre, not synchronously with the heart's action but independently of it. The blood is also seen to be circulating with great rapidity, the corpuscles passing with ease through the capillaries, and showing no tendency to accumulation or adhesion either to one another or to the walls of the vessels. Further, the flow is apparently a steady one, and it is impossible to tell from observation of the circulation when the systole of the heart occurs. In the frog's foot one also sees the pigment-cells in the skin and around the vessels. The pigment consists of minute granules, suspended in the protoplasm of the cells, and the cells are large bodies with numerous branches which anastomose freely with each other. It is by means of these pigment-cells that the frog changes its colour. When the frog becomes dark, the pigment leaves the body of the cell, and becomes diffused throughout the branches. When the frog becomes light, or when it dies, the pigment-granules collect in a dense mass in the centre of the cell. Between these two extremes there are all sorts of gradations. The extreme change is a reflex occurrence, the optic nerve being the afferent one, and variations in the distribution of the pigment are constantly occurring in health.

If the mesentery of a frog is spread out and placed under the microscope, the early phenomena of inflammation may be observed in it as the result of the exposure to the air. The first change seen is a dilatation of the arteries, which begins immediately and is progressive, the diameter of the artery often ultimately exceeding that of the vein; the normal variations in calibre also cease. In some instances, after application of an irritant to a frog's web, a preliminary contraction is observed; but this seems to depend on the nature of the irritant employed, alkalies, tartar emetic, and corrosive sublimate being those especially followed by this preliminary contraction. By-and-by the veins also dilate. At the same time, the rapidity of the movement of the blood increases in the first instance. This is, of course, the converse of a mere physical effect, for, supposing the capillary resistance to remain the same, dilatation of the vessels would be accompanied by decrease instead of increase of rapidity. This acceleration only lasts a short time, however, for the rapidity of the circulation soon becomes slower than normal, the individual corpuscles being readily recognised. This slowing is seen to be due to the fact that the corpuscles now find difficulty in passing through the vessels, more especially through the capillaries, from the tendency they have acquired for adhering to one another and to the walls of the vessels. This leads to heaping up of the corpuscles in the capillaries. The effect of the systole of the heart can be seen, and very soon complete stagnation occurs. This is termed inflammatory *stasis.* This stasis only occurs in the part on which the irritant has acted most intensely; in its immediate neighbourhood the circulation is going on with difficulty, while around the inflammatory area there is dilatation of the vessels and increased rapidity of flow.

These phenomena have been, at various times, attributed to the dilatation of the vessels, to changes in the blood, or to changes in the tissues. Dilatation of vessels alone will not give rise to stasis, as can be seen by division of the sympathetic nerve in the neck leading to dilatation of the vessels of the ear, but to none of the other phenomena of inflammation. The dilatation is, in the first instance, a purely functional phenomenon developed through the nervous system, and often affects a wider area than the inflamed part, as seen in the inflammatory blush. As regards the second point, there is no change in the blood, and no increased adhesiveness of the corpuscles drawn from the inflamed area over those taken from other parts of the circulation. Further, if the margin of the area of stasis is watched, it will be seen that, as the corpuscles pass out of the inflamed area, their tendency to adhere ceases, and they pass on in the healthy blood-vessels as readily as do the other corpuscles. It will also be observed that the corpuscles of fresh portions of blood, as they pass into the inflamed area, acquire this same tendency to adhere, a tendency which they lose again on passing into the healthy vessels. Further, as only one small portion of the blood was acted on by the irritant used, the blood which is present in the area of stasis cannot be that which was acted on by the irritant. That the irritant itself does not necessarily affect the blood is shown by the fact that, if chloroform is applied to the web, inflammation and stasis result, whereas chloroform added to blood prevents the adhesion of the blood-corpuscles. And also, after pinching a part, inflammatory stasis follows, although there can be no action on the blood.

We must therefore conclude that the cause of the slowing of the current and of the ultimate stasis is some alteration which the tissues have undergone, and that the corpuscles, when they pass into the injured area, there acquire the tendency to adhere. Experiments, carried on by Sir Joseph Lister, have shown that the walls of healthy vessels differ from ordinary solids in having no tendency to permit coagulation; but when the walls become unhealthy this power is lost, and there is a tendency to coagulation when the blood comes in contact with them, just as when it touches any ordinary solid. In further explanation of these phenomena, the study of the pigment-cells shows that this state of the walls of the vessels is a condition closely allied to death of the part, but recoverable—a suspension of the functions of the tissue. When death of the pigment-cells occurs, the pigment becomes completely concentrated; this is the constant post-mortem change. When, however, an irritant is applied of sufficient strength to cause inflammation, the pigment instantly ceases to move, and remains in the state in which it was when the irritant was applied, although the frog may afterwards change its colour elsewhere.

We now come to the second series of changes which occur in the early stages of inflammation—viz. the exudation of liquor sanguinis and corpuscles. It has been demonstrated that white corpuscles can move by shooting-out processes, in the same way as amœbæ do, and they also resemble amœbæ in taking up granules into their interior. This double property may be demonstrated by a very simple experiment. Introduce finely-divided cinnabar into the dorsal lymph-sac of a frog, and then put in the dead cornea of some animal. If the cornea is removed in a few days, it will be found that it has become infiltrated with leucocytes containing granules of cinnabar, thus proving that the leucocytes have come from the lymph-sac, and must have got into the cornea by some method of locomotion.

If the centre of a cornea is cauterised with nitrate of silver, the whole cornea will in a few days become more or less opaque, and this opacity will be found on examination to be due to the presence of numbers of leucocytes. If, however, the eye be examined one or two days after the cauterisation, the opacity—i.e. the leucocytes—will be seen in the form of a ring round the margin of the cornea, this ring later on spreading to the centre. If cinnabar was introduced into the lymph-sac before the cornea was cauterised, it will be found that a certain small proportion of the corpuscles in the cornea contain particles of cinnabar. If the cinnabar was injected into the blood-stream instead of into the lymph-sac, the number of corpuscles containing particles will be found to be much greater. Hence, it is clear that part at least of the leucocytes found in the cornea came from the lymph-sac or from the blood-vessels, and as every white blood-corpuscle would not take up the cinnabar, it is probable that the number of corpuscles which have come from the blood is much greater than the number of those which contain cinnabar.

How did these corpuscles get from the blood-vessels into the cornea? They passed out through the walls of the capillaries and smaller veins. This process has been seen to take place in the mesentery of the frog. If the mesentery is spread out on a glass plate, inflammation occurs as the mere result of the exposure to the air, and the whole process may be watched. The dilatation of the arteries and the subsequent slowing of the blood-stream are well seen. If now we observe a small vein, we see the following phenomena. As the circulation becomes slower the individual corpuscles may be recognised, and it will be found that, while the red corpuscles flow more or less in the centre of the current, the white corpuscles roll along the wall of the vessel, often adhering for a time, and then being ultimately detached and swept on, to stick again at another part. By-and-by, as the result of this tendency of the white corpuscles to stick to the wall of the vessel, they begin to collect in numbers, so that the vein becomes lined with a layer of these bodies, which remain almost motionless. If now the outer part of the wall of the vessel be watched, minute, colourless, button-shaped elevations will be seen to spring out, as if they were buds from the wall. These increase gradually till they become hemispherical, and at last a pear-shaped body is seen, the stalk of which is attached to the surface of the vein; gradually this mass of protoplasm becomes completely detached, shoots out processes, and moves on into the tissue. This migration of white corpuscles does not occur in the arteries, but is very rapid in the capillaries, from which red corpuscles have also been seen to escape.

While this is going on, the fluid contents of the blood-vessels also pass out, as the result, apparently, of a leaky condition of the walls of the vessels, and not, as at one time supposed, on account of increased attraction on the part of the tissues. The fluid part soon coagulates in the tissue, or on free surfaces, and this coagulated liquor sanguinis, with entangled leucocytes, forms the lymph which glues the cut surfaces of wounds together, and which is seen on the surface of serous membranes.

Up to this time the original structure of the tissue is still apparent; but if the process goes on longer, changes occur which result in the disappearance of the structure of the part and its replacement by a new tissue, which is called *granulation-tissue.* This name is given to the tissue because its structure is of the same elementary character as that of the granulations seen on the surface of wounds, consisting simply of a mass of roundish cells adhering to each other (i.e. embedded in an apparently homogeneous matrix) and of elementary blood-vessels. It does not matter what the tissue is, or how complex the structure of the organ in which the inflammation occurs; provided the disease has lasted long enough, the special structure of that tissue or organ disappears and its place is taken by granulation tissue. The question now arises, Whence does this new tissue come, and why has the original structure disappeared? As we have already seen, numerous white blood-corpuscles pass out of the blood-vessels during the early stages of inflammation, and some hold that these are the only source of the cells found in granulation-tissue. This view seems, however, exaggerated and difficult to reconcile with various facts, and therefore, while we admit that it is probable that leucocytes or their progeny form part of the cells of granulation tissue, we find that these have other and perhaps more prolific sources.

Irritate cartilage by passing a seton through it, and the following changes will be observed to occur. At a point far removed from the source of irritation, it will be seen that the cartilage-cells become larger and the protoplasm more abundant. The nucleus then divides, both portions remaining still surrounded by the same mass of protoplasm. The protoplasm then divides, and thus we have two cells instead of one, each of which excretes around itself a cartilaginous capsule. Nearer to the injury we find that this division of cells inside the mother capsule has continued, till a large number of young cells have accumulated in it; but these have lost the property of excreting cartilage around them, and they have also become rounder so as to resemble leucocytes. While this multiplication of cells is taking place inside the capsule, its wall is dilating, and the intercapsular cartilaginous substance is disappearing. At length we find that these enlarged capsules have opened into each other and on the surface, where the cells form granulation tissue in which embryonic vessels appear. In this case, as cartilage is devoid of blood-vessels, and as no channels are as yet known by which leucocytes could penetrate into it, we must conclude that the granulation-tissue has been formed from the cartilage-cells. Similar facts have been stated as to other non-vascular tissue, such as the cornea, but there the matter is doubtful. Changes have, however, been observed in the endothelial cells lining the great omentum in adult animals, which seem to point to their hypertrophy and development into round cells.

In vascular tissues, multiplication of the tissue-cells has also been described. In the case of the subcutaneous cellular tissue the connective tissue cells hypertrophy, the fat disappears from the fat-cells, the nucleus divides, and several cells are formed in the original fat-capsule. While these changes are going on in the cells, the fibres of the connective tissue become soaked with fluid, less apparent, and ultimately disappear. The walls of the vessels also undergo changes, the cells constituting them become swollen, their nuclei more apparent, and they soon subdivide, the process ending in the complete disappearance of the old vessels or in the formation of new ones. Similar changes have been described in inflammation of muscle; the fixed corpuscles of the fibre sheaths and the cells of the connective tissue between the bundles of fibres undergoing multiplication, the muscular tissue ultimately disappearing, and being replaced by granulation tissue. That the new cells are formed in this way is often evident from their arrangement in rows corresponding with the position of the muscular bundle.

It thus appears that one, and perhaps the chief, source of the cells which constitute granulation-tissue is from proliferation of the connective-tissue cells of the part; but at the same time it cannot be denied that some are either white blood corpuscles which have passed out of the vessels or are derived from them. The young vessels are probably formed in the same manner as in the embryo.

Results of Inflammation.—1. *Exudation.*—In all inflammations there is exudation, but it varies much in character. As a rule, exudations are fibrinous. The liquor sanguinis escaping from the vessels contains large quantities of fibrinogen, and, meeting with the fibrinoplastic substance and the ferment contained in the tissues, more especially in the cells, it coagulates. At the same time, the white corpuscles also pass out of the vessels, and it is this coagulated liquor sanguinis, with entangled corpuscles, which is known as lymph. In some instances these exudations are of a mucous character, as in joints, and this mucin coagulates on the surface. On serous membranes the lymph, which also contains a little mucin, forms layers on the surface, and this goes by the name of croupous exudation. This croupous exudation also occurs in the lungs in croupous pneumonia, but it is not the same as the false membranes which form in croup, which apparently do not contain fibrin, but consist mainly of epithelial cells soldered together.

2. *Resolution.*—Complete resolution can only occur at an early period in inflammation, before the changes in the tissue have taken place. When resolution occurs, the stasis disappears, the tendency to slowing of the circulation and adhesion of the corpuscles diminishes and finally ceases, the effused and coagulated liquor sanguinis becomes granular, and is removed by the lymphatics, and the white corpuscles which have passed out of the vessels either re-enter them, or pass into the lymphatics, or become fatty and break down. Thus the part returns to its condition previous to the inflammation.

3. *Retrogression.*—In this case the tissue changes have gone on to such an extent that there cannot be a restoration of the original structure; there must be new formation. The character of this new formation varies according to the situation of the inflammation, but it almost always belongs to the class of connective tissues, though sometimes special tissues, such as nerve and muscle, may be regenerated to a slight extent. The changes which take place will be more fully considered under the healing of WOUNDS, but they consist essentially in elongation of the round cells and the formation of connective tissue. The numerous vessels of the granulation-tissue become atrophied as the process goes on, the whole tissue shrinks as it becomes older, and in this way depressed scars form in organs which have been the seat of acute

inflammation, even though suppuration has not taken place. In connective tissue this new tissue resembles connective tissue, in bone it resembles bone, in tendon it resembles tendon; but there is, as has just been said, no reproduction of complex structures.

4. *Suppuration.*—This process is described in detail under SUPPURATION.

5. *Ulceration. See* ULCERATION.

6. *Sloughing. See* SLOUGH AND SLOUGHING.

So far we have been considering acute inflammation, but there is another variety termed chronic inflammation, in which the changes above described take longer in their development, and differ somewhat in their results. As a consequence of chronic inflammation there is, as in the acute form, destruction of the tissue of the part and its conversion into granulation-tissue, but from the very first retrogressive changes are marked. Thus, in a part the seat of chronic inflammation, there may be very few round granulation cells, the majority having become spindle-shaped, and many of them having formed fibrous tissue. Chronic inflammation may go on without the occurrence of suppuration, or it may lead to suppuration or ulceration. When chronic inflammation continues without suppuration or ulceration, the inflamed part may assume two forms—one in which it becomes much larger than normal, and the other in which it actually becomes smaller. The latter form is probably preceded in its earlier stage by enlargement of the part. In white swelling of the knee-joint we have a good example of enlargement of a part as the result of chronic inflammation. If we examine a specimen of the inflamed synovial membrane, we find that there are numerous granulation cells in places, more especially around the vessels, but that the tendency is for these cells to become elongated and spindle-shaped, and to develop fibrous tissue. This fibrous tissue, however, remains swollen and imperfect, and the individual cells are often widely separated from each other by swollen intercellular substance. At parts the white cells become heaped together, and here abscesses may form. The appearances in this form are further complicated by the presence of tubercles at various parts. In the second variety of chronic inflammation the swelling of the intercellular substance is less marked, and the formation of fibrous tissue is the chief thing that is noticed. The result of this formation of fibrous tissue is that, as it contracts, it presses on the tissue in its vicinity and causes it to atrophy. This is well seen in cirrhosis of the liver. The results of chronic inflammation are retrogression, suppuration, and ulceration.

Varieties of Inflammation.—As we have seen, inflammation is a complex process consisting of congestion, exudation, new formation, suppuration, &c. One of these may be more prominent than the others, giving the inflammation a special character and leading to the formation of distinct varieties of inflammation.

1. Congestion may be most marked, as in the cutaneous erythemata, erysipelas, acute catarrhs, rheumatic inflammation of joints, &c.

2. Exudation may be the main element, as in pneumonia, pleurisy, pericarditis, &c.

3. Some inflammations are essentially suppurative, as those which occur in the course of pyæmia, puerperal fever, &c.

4. New formation may be the chief feature, as in periostitis, cirrhosis, &c.

In tuberculosis and syphilis the inflammations also present special characters.

Etiology of Acute Inflammation.—We have already defined inflammation as 'the succession of changes which occurs in a living tissue when it is injured, provided that the injury is not so severe as at once to destroy its structure and vitality; the extent of these changes depending on the length of time and the energy with which the cause acts.' We may therefore divide the immediate causes of inflammation into groups according to the length of time during which they act. The predisposing causes may be considered afterwards.

1. Some causes only act transiently, and corresponding to this transient action the inflammation soon ceases. In some cases, as possibly in the action of cold, the inflammatory phenomena do not go beyond the early stage, and resolution occurs in a few hours if no serious damage has been done to the part, or if no further cause keeping up the inflammation comes into play. The best example of the action of a transient cause is seen in the healing of a wound by first intention. The knife in its passage through the tissues causes damage, which results in the occurrence of the early stages of inflammation and the exudation of liquor sanguinis and white blood-corpuscles. But the cause having ceased to act and no fresh cause having come into play, the inflammation ceases, organisation of the exudation takes place, and the wound heals.

Whether, apart from any direct damage done to the tissues by mechanical or chemical agencies, disturbance of the nervous system alone can set up and maintain inflammatory action, is a very moot question, although held by some. In any case, it seems improbable that nervous disturbance alone could keep up an acute inflammation and lead to suppuration.

2. Most of the causes act longer and more intensely, and set up a correspondingly severe inflammation. Various chemical substances, such as croton oil, tartar emetic, blistering fluid, &c., act for some time, and even after one application cause pustules or blisters. Why croton oil on the one hand should cause pustules, and blistering fluid on the other hand cause vesication, is as yet quite unexplained. Other chemical substances only cause a slight amount of inflammation at a single application, but, if frequently applied, will even set up suppuration; such are carbolic acid, iodine, &c.

3. In contrast to these various causes are those which, when once introduced, go on acting for a long time, and may produce various results, such as fibrous formation, suppuration, ulceration, gangrene, &c. Of these, certain foreign bodies may, by their mechanical action, keep up a state of inflammation leading to fibrous formation or to suppuration. But the most common causes are self-multiplying agents, the living ferments or micro-organisms. And seeing that almost all acute inflammations are due to some cause which goes on acting for a considerable time, and that in these cases micro-organisms are always present, we must conclude that the great majority of inflammations, and more especially of suppurations, are intimately connected with the growth of these organisms. In all acute abscesses, and in almost all suppurating wounds, micrococci are present, which are without doubt the cause of the suppuration; and they probably cause the inflammation by forming, as the result of their growth, products which irritate the tissues and cause them to inflame. It is in the highest degree probable, that it is the absorption of these same products into the circulation which produces the general febrile disturbance.

The character of the inflammation depends to a great extent on the species of micro-organisms present, for there are several different kinds associated with inflammation. Thus, one variety produces erysipelas, others cause the formation of abscesses, and others again cause phagedæna or spreading gangrene. But though much depends on the kind of organism present, much also depends on the place where it grows. Thus, the *staphylococcus pyogenes aureus*, growing in the cellular tissue will cause an ordinary acute abscess, growing in the glands of the skin will cause a boil or carbuncle, and growing in bone will cause acute osteomyelitis. Here the result is dependent mainly on the anatomical structure of the part. As has just been remarked, there are various micro-organisms associated with inflammation, and even an acute abscess is not always caused by the same species. Some of these will set up the disease at once, without any previous injury of the tissue predisposing to inflammation; others, apparently, act only when present in large numbers, and in a tissue already in the early stages of inflammation. When, for instance, a wound fails to heal by first intention, it is generally due to the entrance of micro-organisms. The tissue is already in a state of inflammation, as the result of the injury done by the knife, but this would soon subside, as the cause has ceased to act; but if micro-organisms, capable of growing in tissues, obtain entrance, they form a further and continuously acting cause of inflammation, and lead to continuance of the process and ultimately to suppuration.

Predisposing causes are causes which depress the vital powers, and may be divided into general and local. Of the general causes we may mention drunkenness, exhaustive diseases, starvation, bad food, ingestion of decomposing matters, &c. Under these conditions the vitality of the tissue is much diminished, repair after injury does not take place so readily as in a state of health, and in this enfeebled state a lower degree of irritation or injury is required to produce inflammation, than is the case under normal conditions. But, in the opinion of the writer, this is not the only mode in which these causes act: they also permit the entrance of the living exciters of inflammation — micro-organisms—into the body. When the body is healthy, no living organisms (except, of course, certain pathogenic ones) can penetrate into the blood, or, if they do reach the blood alive, they soon die. Hence, a collection of blood (hæmorrhage after a blow), or a piece of dead tissue (as in an infarct), may lie in the body without giving rise to acute inflammation—may, in reality, become absorbed and disappear. But where the vital powers are depressed, as by bad food, drunkenness, &c., micro-organisms may enter the circulation, and, not being destroyed at once, may become deposited in the piece of dead tissue or in the collection of blood, and, growing there, set up inflammation. The low state of health thus predisposes to inflammation by permitting the entrance into the circulation of living micro-organisms. This has been experimentally proved in the lower animals, by feeding them on very foul putrid material and then causing subcutaneous hæmorrhages; abscesses containing micro-organisms have resulted. In Chauveau's experiments on *bistournage*, the effect of the presence of micro-organisms in the tissues was demonstrated. In the operation of *bistournage* the testicle is twisted till the cord and vessels are ruptured, the result being that the organ atrophies and disappears. But if, before *bistournage* is performed, a quantity of septic material be injected into the circulation, the testicle on which this operation is performed becomes inflamed, and a septic abscess results. And the writer has observed in the case of a drunkard suffering from albuminuria, and in a low state of health generally, that whenever he received a bruise, an abscess containing micrococci formed at that part.

Certain specific states of the system, as the gouty and rheumatic diatheses, are also often reckoned as predisposing causes, though they hardly come into the same category as the above.

The local predisposing causes are likewise such as lead to imperfect vitality of the part, such as local congestions, say from varicose veins, atheromatous arteries, imperfect innervation, &c.

Symptoms.—The symptoms of inflammation, both local and general, vary with the seat and intensity of the inflammation. Let us take a simple acute inflammation of the subcutaneous cellular tissue as the type. The symptoms are subdivided into local and general.

Local Symptoms.—The cardinal symptoms of inflammation are redness, heat, swelling, and pain. The redness may or may not disappear on pressure. At the marginal part of the inflammatory swelling the redness is of a bright colour, and disappears readily on pressure; it is there due simply to dilatation of the blood-vessels. Towards the centre of the swelling the redness is of a darker colour, and often persists in great part on pressure; there it is due to stasis in the blood-vessels or to extravasation into the tissues, or, it may be, to migration of large numbers of red blood-corpuscles. The swelling is due to the exudation of liquor sanguinis and blood-corpuscles. The pain is caused by pressure of the exudation on the sensory nerves either from the outside, or probably more generally by exudation into the sheath of the nerve itself. The heat is partly due to the increased flow of warm blood through the part, raising the temperature of an external part to that of the blood in the internal organs. Apparently, however, according to the researches of Mr. Simon, there is also a local production of heat in the inflamed part, the temperature of the venous blood leaving an inflamed part being higher than that of the arterial blood entering it.

Constitutional Symptoms.—Along with these local effects there is more or less disturbance of the general condition of the patient, varying in character chiefly according to the intensity and cause of the inflammation. The first symptom of inflammatory fever is generally a feeling of chilliness, followed by heat; the patient may even have a shivering fit. The temperature rises, the height varying with the intensity of the inflammation; it generally reaches 102° to 103° in from twenty-four to forty-eight hours, remains at that height for about twenty-four hours, and then, in the case of an open wound, as suppuration occurs, it rapidly falls till, on the fourth or fifth day, it is again normal. The pulse becomes quick, hard, and wiry; the tongue becomes dry and furred. The secretions are diminished or arrested; the skin hot and dry; the urine scanty and high-coloured; the bowels constipated. There is also headache, and, where the symptoms are severe, there may be delirium. The other symptoms disappear, along with the fall of temperature, when suppuration takes place in the case of an open wound, provided that no complication has occurred.

As has been previously remarked, the local and constitutional symptoms of inflammation vary according to the seat, intensity, and cause of the inflammation. The details of these symptoms will be found under the proper headings; it will be sufficient here to illustrate what is meant. In acute suppurative periostitis or osteomyelitis the pain is intense, but—especially if the bone be deep-seated, as the femur—swelling is little, if at all, noticeable. At the same time, the constitutional symptoms, which at first were those of inflammatory fever, soon undergo a change and resemble those of septicæmia; in fact, the patient suffers from septic poisoning due to absorption of septic products from the inflamed bone. Another example of the influence of the site of the inflammation on the symptoms is seen in whitlow, where the local symptoms and constitutional disturbance are out of all proportion to the extent of the affection. The cause of the inflammation also determines the severity of the symptoms. The passing inflammation which follows a cut or an injury is so slight, that it is not recognised as inflammation at all by many writers; while, in the infective inflammations, the symptoms are characteristic and generally severe.

When the inflammation is chronic, the symptoms are much less marked. There is generally no increased redness over the part, and the vascularity of the part itself is not nearly so great as in the acute. There is but little pain or tenderness, and even where in some situations, as in the periosteum, pain and tenderness are present, they are not as a rule severe. There is no increased heat of the part. As regards the constitutional symptoms, these depend on the same cause as the chronic inflammation rather than on the inflammatory process itself.

Treatment of Acute Inflammation.—In considering the treatment of acute inflammation, we must first speak of acute inflammation in connection with a wound or injury, and secondly of acute inflammation occurring without any evident wound. And the reason for this separation is the fact that, in the first class of cases, much may be done by preventive measures; while, in the second class, the cause has generally begun to act before we know that it is there, and, therefore, we can only use curative measures.

Preventive Measures. — The various local causes of inflammation in wounds may be summed up in the one word—unrest; and the causes of unrest are mechanical or chemical. The mechanical causes of unrest are movements of the part, either of a limb as a whole or of individual muscles, also pressure as from a pad in the wrong place, pressure of a splint, &c.; further, such causes as the weight of flaps, placing the limb in an extended position when a flexed position would allow the edges of the wound to lie easily together or *vice versâ*, allowing a limb to hang, thus impeding the circulation, tight stitches, &c. The chemical causes of inflammation are irritating chemical substances, but, more especially, decomposition in the discharges of the wound, from the growth of micro-organisms in them or in the tissues of the wound itself. These local causes being understood, it is quite plain how they must be remedied. Rest must be secured in one way or another. Mechanical rest will be secured by keeping the part still, in the case of an extremity by the application of a splint, by keeping the extremity elevated, by seeing that the position is such as to separate the parts as little as possible, and by avoiding pressure, tight stitches, &c. Chemical rest is obtained by avoiding the application of irritating chemical substances to the wound, but more especially by taking measures to exclude micro-organisms. In cases where aseptic treatment cannot be thoroughly carried out, means must be taken to hinder the development of micro-organisms, as much as possible, in some of the ways described in the article on Antiseptic Surgery, by free drainage, avoidance of tension, antiseptic irrigation, &c. The unrest produced by decomposition and growth of micro-organisms being much more serious than that caused by the application of antiseptics, the latter—the lesser of the two evils—must be chosen.

At the same time any general condition which predisposes to inflammation must be remedied as far as possible. Good food must be given (it is quite a mistake to keep a patient on low diet with the view of preventing inflammation); if necessary, stimulants, and tonics such as iron and quinine, while any constitutional peculiarity, such as gout, syphilis, &c., must be treated by specific remedies.

With regard to preventive treatment, it must be borne in mind that inflammation of glands may occur from absorption of poisonous (phlogogenic) materials from wounds. This can be avoided by preventing the development of these materials in the wound, as by antiseptic treatment.

The *curative* treatment of inflammation in wounds will be found under Wounds.

We next pass on to inflammation occurring without evident connection with an external wound, such as acute abscess. Here, as has been previously remarked, the inflammation has already begun before we see the case, and, therefore, preventive treatment does not come into play; though, if the inflammation be dependent on some constitutional state, attempts may be made to remedy that with the view of preventing future attacks.

1. Here, as in the preventive treatment, rest is a most important element. The inflamed part should be kept still; if an extremity, it should be laid on a splint and elevated. Special apparatus is required for special cases, and these will be found described under the proper headings. Thus, for an inflamed joint it is not only necessary to secure rest by means of splints or sandbags, &c., but the tendency to spasmodic contractions of the muscles

must be counteracted by a suitable extension apparatus.

2. The second point which is aimed at, in the treatment of acute inflammation, is to diminish the vascular excitement. This is attempted in three ways.

a. By the application of cold with the view of causing contraction of the arteries. That cold does act in this way even on deep-seated parts there can be no doubt; it is constantly evidenced by the effect of cold in checking hæmorrhage. Not that the cold need penetrate to the seat of inflammation; its effects are produced by reflex action. The necessary cold may be obtained by the application of ice or cold water or evaporating lotions. The ice is conveniently enclosed in a thin india-rubber bag, so that the skin remains quite dry. Ice-cold water is conducted through a coil of metal tubes (Leiter's tubes), which can be laid over the part or made to surround it. By means of a continuous flow of iced water through Leiter's tubes a constant low temperature is maintained, and this is in reality the most satisfactory method of applying cold. It is dangerous to apply ice or cold water directly to the skin, for it has been found that there is a great risk of frostbite and gangrene if this is done. On the other hand, with dry cold this danger is not nearly so great, though, at the same time, this method of treatment must always be employed with caution. As a rule, it is only useful in the early period of the inflammation, and when its application ceases to give the patient relief, it is time to discontinue it. By the use of evaporating lotions a certain amount of cold may be produced. Of these the most commonly employed are spirit and lead lotion or hydrochlorate of ammonia and spirit (Ammon. chlor. ℥ss., Spirit. rect. f℥j., Acidi acet. dil. f℥jss., Aq. ad f℥viij.). Whatever means of producing cold is employed, it must be continuously applied; intermittent applications only do harm.

b. By local or general depletion, by which a similar contraction of the arteries is brought about. Local depletion is carried out by means of leeches, cupping, or scarification. Great relief, and at least temporary improvement, is generally experienced as the result of this treatment. More effectual than these methods are free incisions, but this will be referred to again. General blood-letting hardly comes into consideration in the treatment of surgical inflammations.

With the view of diminishing the flow of blood to an inflamed part, it has also been suggested, and in some cases successfully practised, to compress or ligature the main artery leading to the part. This has been chiefly employed in inflammations of joints or bones, more especially after gunshot injuries.

c. By the use of the so-called antiphlogistic remedies. Of these the most generally recommended are antimony and aconite, more especially the former. Antimony is first given in sufficient doses to produce vomiting, and then is continued in small doses. For the same purpose laxative and purgative remedies are also used. These to a certain extent act like blood-letting by withdrawing fluid from the body, but probably their chief action is by the removal of waste products and by counter-irritation.

Where the inflammation is extensive and the febrile symptoms are of the acute sthenic type, the diet ought to be restricted; as a matter of fact, the patient has lost all appetite, and thus restricts his diet himself. Where the fever is of the asthenic type, depletion and antiphlogistic remedies are contraindicated, the diet ought to be of the most nourishing and easily assimilated kind, and tonics, quinine, and iron should be given. In addition to antiphlogistic remedies, benefit will often be obtained by the administration of sedatives, more especially of opium.

3. A third indication is to get rid of foreign bodies and to relieve tension. The greatest benefit is derived, in acute inflammations, from free incisions through the inflamed parts, even though suppuration has not yet occurred. Of course, these incisions must be made with all aseptic precautions, so as to prevent the entrance of fresh causes of inflammation. If this is done the process will very often cease, and there is no more striking instance of the benefit to be derived from free antiseptic incisions in the early stages of acute inflammation, than the results obtained in cases of acute periostitis or acute necrosis. The disease often ceases at once, and no dead bone comes away. Free incisions act to some extent by depleting the part, but chiefly by relieving tension, for tension is one of the chief causes which assist in keeping up inflammation in a part.

4. Counter-irritation, though more especially useful in chronic inflammation, is also very valuable in the acute disease. There, however, the more severe forms are but seldom employed. In deep-seated inflammations, as in acute meningitis, blisters may be used with advantage. In other

cases, as, for example, in the early stage of glandular inflammations, iodine is useful. But the most common form of counter-irritant employed, in acute inflammation, is the poultice or warm fomentation. How counter-irritants act in arresting inflammation is still purely hypothetical, but the most feasible view is that it is through the agency of the nervous system. Gonorrhœa ceases or diminishes during the occurrence of acute epididymitis; in mumps the parotid gland recovers as soon as the ovaries or testes become inflamed, &c. So, apart from the relief afforded by the warm and moist application, the use of a poultice often diminishes the inflammation deeper down, by reflex action. On the other hand, when once suppuration has begun, it seems to favour the further development of pus and the rapid 'ripening' of the abscess.

5. Certain acute inflammations are readily subdued by the use of specific remedies. Thus, gout is rapidly and favourably affected by colchicum, rheumatism by salicylate of soda, and syphilis by mercury or iodide of potassium.

Treatment of Chronic Inflammation.—Here, again, rest and a suitable position are essentials in the treatment, and the same principles have to be followed as in the treatment of acute inflammation. At the same time much good can be done by more active measures, such as counter-irritation, pressure, and various internal remedies.

The counter-irritants employed are of a more severe nature than in acute inflammation. The best are the actual cautery and blisters. The actual cautery is especially useful in deep-seated chronic inflammations, especially of joints, and in this case it must be thoroughly applied. Better than the button cautery, is the application of the cautery iron over a considerable extent of the skin, in the neighbourhood of the inflamed part. All that is desired is to destroy the surface of the skin, and not the whole of the true skin, and for this purpose the cautery should be at a white heat and rapidly drawn over the surface two or three times. For a few days poultices are applied, till the sloughs separate, and then the sore is dressed with savin ointment and kept open for about six weeks. If it tends to close sooner, in spite of the savin ointment, the healing edge can easily be destroyed by nitrate of silver or by potassa fusa. Issues may also be produced in the first instance by potassa fusa or by chloride of zinc paste, or, in some cases, setons are used. Repeated blistering is also of great benefit in chronic inflammations, and iodine is a favourite application with some, especially for enlarged glands.

Pressure is an excellent remedy in many chronic inflammations, and may be carried out by means of elastic bandages, cotton-wool firmly bandaged on, &c. *See* PRESSURE. In addition to pressure, massage of the part, more especially of a diseased joint (synovial disease), has been strongly recommended. The part is well shampooed once or twice a day for a quarter to half an hour, the pressure being especially applied in the direction of the trunk, with the supposed view of aiding the lymphatic circulation. On the principle of relief of tension, free antiseptic incisions have also been made in chronically inflamed tissues, such as diseased synovial membrane, with excellent results.

In chronic inflammations much benefit may also be derived from suitable constitutional treatment. Nourishing diet, and stimulants if necessary, are administered, along with cod-liver oil, iron, and other tonics, passive exercise in the open air, &c. Of course, in specific inflammations, the suitable specific remedies are invaluable, such as iodide of potassium in syphilis, &c.

W. WATSON CHEYNE.

INGROWING TOENAIL.—This apparently slight affection may become an extremely painful and crippling one. It is met with chiefly in adolescents, more often males, and is due to the pressure of the nail of the great toe into the soft parts, either from the wearing of ill-made boots, with pointed crowding toes, or from the rounding off the angles of the nail instead of cutting them square, and thus allowing the soft parts to encroach beyond their proper limit. The affection may be met with on either side of the nail. The first stage is tenderness, followed by ulceration. When this has lasted any time, a little mass of prominent and very tender granulations is met with at the affected spot, accompanied by unhealthy, foul discharge.

Treatment.—In the earlier stages, a few days' rest, with the foot in the elevated position, the use of lead lotion, allowing the nail to grow square, and, above all, the use of well-made boots, with straight inside borders and room for the toes, will be sufficient. But, later on, when ulceration is present, it is imperative that the pressure of the nail on the soft parts be removed. This may be effected by the following means:—The edge of the nail being raised by a flat, narrow, spoon-shaped spatula, or even by a piece of wood of appropriate size and shape, shreds of lint pressed out of carbolic oil (1–30), or dusted with iodoform, are to be carefully packed with a probe between the nail and the soft parts, so as to press back the latter and elevate the buried nail. The quantity of shredded lint should be gradually increased every second or third day, till the nail is thoroughly raised from its bed in the soft parts. A better plan than the above, in that it requires fewer applications, is the introduction of a small, narrow piece of sheet lead under the edge of the nail. The nail being raised, as directed above, a narrow slip of metal, about two inches long, and slightly overlapping the nail, is introduced well beneath the ingrowing border, and then gently bent over and firmly pressed into position on the upper surface of the nail. Then, any superfluous metal being cut away, the strip is retained in position by narrow strapping and the use of a covering, like the finger of a glove, which is secured round the ankle by tapes. As attempts at introducing anything under the nail are often rendered futile by the pain they cause, it is best to give ether on the first occasion. Professor Humphry, from whom the writer learnt the above method, recommends silver rolled thin enough to bend easily. This raises the nail more efficiently than lead, but is more difficult to obtain. The administration of ether will also enable the surgeon to destroy thoroughly the prominent, painful, and fetid granulations which accompany this affection, by means of undiluted carbolic acid, acid mercury nitrate, silver nitrate, &c. Where the granulations resist the above, and the soft parts overhang the embedded nail, it will be found best, ether being given, to remove by one stroke of a sharp-pointed bistoury the soft parts at the side affected, including the above granulations. This step leaves a healthy sore, which, contracting quickly as it heals, leaves nothing for the nail to press upon.

The surgeon, failing with lint, or not being able to provide himself with metal, may place a bit of sponge-tent, wrung out of carbolic oil, or well powdered with iodoform, under the nail. The point of chief importance is to well elevate the nail on one or two occasions, by means of the above-mentioned spatula. When once this has been thoroughly effected, the pressure of the body well introduced, especially if this be metal, causes atrophy of the ingrowing granulations and soft parts beneath.

Where the patient refuses any operative interference, the granulations and soft parts over the nail must be drawn away by strapping, while iodoform, pulv. æruginis, powdered lead nitrate, lotions of copper or iron sulphate (gr. iv.–f℥j.), are perseveringly applied, and the centre of the nail rubbed down from matrix to edge with glass or a blunt knife, to cause its shrinking.

Removal of the nail is only to be employed in a limited number of cases, for it must always be remembered that, while the new nail may, with proper attention, grow straight and healthy, it may, on the other hand, assume a faulty direction, and appear, in addition, uneven and distorted, owing to injury inflicted on the matrix at the time of the evulsion, aided by preceding inflammation. Where the patient finds the introduction of the lint or metal unbearable, where in advanced cases previous treatment has failed, or where the nail is loosened or much diseased, evulsion is to be practised. The patient being under the influence of nitrous oxide or ether, one blade of a broad-bladed, stout dressing-forceps is driven down close to the nail as far as its root; the blades are then closed, and the nail, loosened by one or two lateral twists, is withdrawn by a direct pull. If it be desired to remove one half of the nail only, this should be first divided by the introduction of sharp-pointed scissors. In removing the nail, sufficient care is not usually taken to inflict as little injury as possible on the subjacent matrix. After removal the surface left should be dressed with iced lead lotion, carbolic oil (1 in 40), iodoform or powdered lead nitrate, and the patient should lie up on a sofa for a day or so, then going about with an easy shoe. *See* Nails, Diseases of the.

W. H. A. Jacobson.

INGUINAL HERNIA. — Inguinal ruptures may be divided into two great classes: 1. The external, oblique, or indirect. 2. The internal, or direct.

1. The External or Oblique Hernia. In this form the rupture occupies, in whole or in part, the inguinal canal. This canal runs obliquely from the internal to the external abdominal ring, and is about $1\frac{1}{2}$ inches in length. The external ring is readily felt, in the male, by invaginating the scrotum with the point of the finger, and then passing the digit up in front of the cord. If the nail be kept against the cord, the pulp of the finger can readily recognise the triangular, slit-like opening. In normal conditions in adults it will just admit the tip of the little finger. In females the ring is somewhat less easily felt, owing to the

slighter laxity of the tissues of the labium pudendi. The internal ring is situate about half an inch above the middle of Poupart's ligament. The neck of the sac is at the internal ring, and just to the outer side of the deep epigastric artery. The hernial tumour, as it occupies the canal, lies in front of the structures forming the spermatic cord. The protrusion may appear merely as a bulging at the internal ring. It may occupy the inguinal canal, but not project beyond the external ring, in which case it is called a bubonocele. It may project beyond the outer ring, and may occupy the scrotum or labium (scrotal or labial hernia).

In external inguinal hernia the sac may be either acquired, or it may exist ready-formed, owing to certain congenital defects in the processus vaginalis.

The acquired hernia in this position is comparatively rare before adult life, and is much more common in men than in women. It forms slowly, but in time it may attain very considerable dimensions. In old acquired, herniæ not only do both the abdominal rings become much enlarged, but they are also approximated, so that a time comes when the internal ring is almost directly behind the external ring, and the inguinal canal has practically no existence. When such herniæ are reduced, they appear to go directly back into the abdominal cavity.

The oblique hernia, depending upon congenital defects in the processus vaginalis.—The descent of the testicle in the fœtus is preceded by the passage into the scrotum of a process of the peritoneum—the vaginal process. The testicle usually enters the internal ring abouth the seventh month of fœtal life, and by the eighth month is in the scrotum. The vaginal process is often found open at birth, and even for two, three, or four weeks after birth; but it is more usually found cut off from the peritoneal cavity, the portion thus isolated forming the tunica vaginalis. The manner in which it is cut off is as follows:—It becomes obliterated in two places, at the internal ring, and at a spot just above the epididymis, the obliteration usually beginning at the higher point first, and proceeding downwards. Supposing obliteration to have taken place at these two points, the vaginal process between them will be represented by an isolated tube. This soon shrinks, closes, and dwindles to an insignificant fibrous cord. It may, however, remain patent in part, and, if fluid accumulates in this patent portion, an encysted hydrocele of the cord is produced.

As regards the mode of closure three contingencies may happen, each giving rise to a particular form of hernia: (1) The process may not close at all. (2) It may close at the upper point only. (3) It may close at the lower point only.

(1) When the vaginal process is entirely open, gut can readily descend at once into the scrotum. Such a condition is called a *Congenital Hernia.* This form of rupture may be met with at birth, or may appear for the first time some months, or even years, after birth. When a rupture, having all the characters of a congenital hernia, appears for the first time many years after birth—say at the age of seventeen or twenty—the condition of parts is probably that found in cases where an infantile hernia may exist. The congenital hernia appears suddenly, and may pass at once into the scrotum.

(2) When the process is closed only at the internal ring, there is merely a thin septum between the peritoneal cavity and the cavity of the tunica vaginalis. The gut pressing upon this septum may push it before it, or come down behind it. In either case, three layers of peritoneum would have to be cut through before the gut could be reached. This is the *Infantile Hernia* of Hey, or the *Encysted* of Sir Astley Cooper. This hernia is not congenital, but is most commonly met with in infants and young children. It has been seen, however, for the first time in patients of seventeen, thirty, and thirty-five years of age.

There are no special features by which the rupture can be certainly diagnosed before the parts are exposed in herniotomy. It has the ordinary aspect and relations of an oblique inguinal hernia. It forms more gradually than does the congenital rupture, and seldom attains the same dimensions. An oblique inguinal rupture, of slow formation, in a patient under the age of puberty will probably be of this type. The condition of parts that favours the development of this rupture serves also to explain those anomalous cases of congenital hernia which appear suddenly, and for the first time, in adult life. Here, under some unwonted exertion, the septum above described gives way, and the gut at once passes into the cavity beyond, and so appears in the condition of a congenital hernia.

(3) In the last of the three above-named contingencies, a tubular process of peritoneum leads down as far as the top of the testicle, and there ends, the normal tunica vaginalis being beyond. Hernia into this

process is called a *Hernia into the funicular process.*

In the first of these three forms the testicle is quite enveloped in the hernia. In the second and third forms, as well as in the acquired form, it is distinct from the rupture, being behind and below it.

It is important to distinguish between the congenital and the acquired forms of inguinal hernia. In the congenital variety the rupture appears very early in life, and usually develops suddenly, whereas the acquired form is rare before puberty, and is of gradual development. In the former, the relations of the two abdominal rings remain unchanged, and the testicle is enveloped in the tumour. In the latter, the abdominal rings tend to become approximated, the testicle is distinct, and is to be felt behind and below the swelling. The congenital hernia is globular; the acquired, pyriform. The congenital hernia is much more liable to strangulation, and, when strangulated, is much more difficult to reduce by taxis.

The inguinal canal in the female is much smaller and narrower, although a little longer, than it is in the male. It offers such slight inducement to the formation of a rupture, that acquired inguinal hernia is quite rare among females. In the female fœtus a process of peritoneum descends for a little way along the round ligament, and is known as the canal of Nuck. If this process remain patent, as it not unfrequently does, it may lead to a rupture that corresponds to the congenital hernia of males. Indeed, in quite early life, the inguinal rupture is about the only form met with in female children, with the exception of umbilical hernia. In all such instances of early inguinal hernia, the gut has travelled down a patent canal of Nuck.

2. Internal or Direct Hernia.—In this form, the hernia leaves the abdomen through the space known as Hesselbach's triangle, and to the inner side of the deep epigastric artery. There may be two forms of direct hernia. In one form the gut escapes through the so-called middle fossa —a depression in the peritoneum between the epigastric artery and the obliterated hypogastric vessel; in the other, through the inner fossa between the hypogastric artery and the outer edge of the rectus muscle. The middle fossa is nearly opposite to the summit of the external ring. A hernia, escaping through that fossa, would enter the inguinal canal some little way below the point of entrance of an oblique hernia, and would have the same coverings as that hernia, with the exception of the infundibuliform fascia. The inner fossa corresponds with the external ring. A rupture escaping through this fossa is resisted by the conjoined tendon and the triangular aponeurosis. These structures are either stretched over the hernia so as to form one of its coverings, or the conjoined tendon is perforated by the hernia, or, lastly, the gut deviates a little in an outward direction so as to avoid the tendon and appear at its outer side. In any case, the hernia is forced almost directly into the external abdominal ring.

In distinguishing a direct from an indirect inguinal hernia, it must be first noted that the direct hernia is never congenital. In the oblique form the cord is behind the tumour, in the direct it is behind and external to it. In the congenital oblique hernia, and in recent examples of the acquired form, the rupture takes the direction of the inguinal canal, while the direct hernia has its axis almost, if not quite, parallel with the middle line. As has been already pointed out, old oblique herniæ lose a good deal of their obliquity, and, in time, present an axis which is not very divergent from that of the direct hernia. After the reduction of a direct rupture, the edge of the rectus muscle may be readily felt to the inner side of the aperture, and the pulsation of the epigastric artery may be detected on its outer side—features that are both lacking in the oblique variety. Finally, the direct hernia is usually much smaller than the oblique, and assumes a more globular outline.

Speaking generally, it may be said that inguinal herniæ, as a rule, contain small intestine, and often some omentum. In rare cases the rupture has contained the cæcum, the sigmoid flexure, an ovary, and the bladder. In cæcal ruptures there may be no sac, or only a partial one. When the bladder occupies the tumour, there is no sac.

Inguinal hernia is ten times more common in males than in females. It occurs with greatest frequency during the first ten years of life; it then diminishes in frequency, and rises again to attain the second maximum between the ages of twenty and forty. After forty it once more diminishes in frequency.

Inguinal herniæ have been mistaken for hydrocele, hæmatocele, varicocele, and other scrotal tumours; for tumours of the cord, for glandular enlargements in the inguinal canal, for suppurative collections in the canal, for retained testis. For the differential diagnosis of these affections the reader is referred to the article Groin.

In applying *taxis*, the thigh should be flexed and a little adducted. In congenital herniæ, and in recent acquired herniæ of the oblique variety, the pressure should be in the direction of the inguinal canal. In direct ruptures, and in old oblique herniæ that are not congenital, the pressure should be applied almost directly backwards.

In performing *herniotomy*, the external incision should be about 1½ or 2 inches in length, should be made along the middle of the tumour, and in its long axis, and should be so arranged that its centre shall correspond to the external ring. The superficial external pudic vessels are usually divided in the operation. It is impossible to distinguish the various layers of tissue that cover the hernia, the only one, as a rule, that is recognisable, being the cremasteric fascia. In dividing the constriction, it is recommended to cut upwards in all forms of inguinal hernia. The only vessel in risk of damage is the deep epigastric. In the oblique rupture, an incision directly upwards would quite avoid this artery; but in a direct hernia, where there is reason to suppose that the vessel is in close connection with the neck of the sac, it is well that the incision be directed a little inwards as well as upwards.

Frederick Treves.

INHALATION. *See* Anæsthetics.

INNOMINATE ANEURISM, uncomplicated by dilatation of the arch of the aorta, is of rare occurrence, and the difficulty of distinguishing it from purely aortic aneurism is confessedly great.

Symptoms.—The presence of a pulsating swelling in the region of the right sterno-clavicular articulation, which may be bulged forward or actually invaded by the tumour in its progress to the episternal notch, points to either an innominate or an aortic aneurism, or a combination of the two diseases. Deficient resonance is to be found over the upper third of the sternum, the inner half of the clavicle, and probably over the infra-clavicular region. A *bruit* may, or more probably may not, be present in the tumour, but the heart's sounds are apt to be propagated very clearly into the tumour, and, according to Barwell, while both sounds are heard as plainly as over the cardiac region, it is the second sound which is more especially exaggerated, being often louder than the first. Congestion of the veins of the right side is an early and marked symptom, and, later on, congestion of the left side may follow compression of the left innominate vein by the tumour. The diminution of pulse in both the right arm and neck is an important symptom of innominate aneurism, though not conclusive, since disease of the aorta at the origin of the innominate may give rise to the same symptoms. Dyspnœa and inability to assume the recumbent position are common in cases of innominate aneurism, and dysphagia is not an infrequent symptom.

Treatment.—The treatment of an innominate aneurism by rest and diet is singularly unsatisfactory, the disease making progress so soon as the patient resumes his ordinary habits, and ending before long in death by rupture, or by fatal pressure on the trachea.

The surgical treatment resolves itself into some form of distal ligature, for there can never be room to apply a ligature on the proximal side of the disease. Ligature of the common carotid, of the third part of the subclavian, and of both arteries consecutively or simultaneously, have all been tried, with varied results. According to Erichsen, of the cases in which one vessel alone was tied, in sixteen fatal results were accelerated, in three the progress of the disease was not materially interfered with, in two it was arrested, and in one the result was uncertain, and in one case only was the disease cured. Simultaneous deligation of the two main trunks, on the other hand, seems to have produced a cure in two cases of Barwell's, and one of King's, and to have given great relief in several other instances, both of innominate aneurism and of aneurism which proved eventually to be mainly aortic. Whatever may be the correct theory of the action of the distal ligature (*see* Aneurism), there can be no doubt that the double distal ligature does produce a marked effect upon aneurisms presumably innominate, and that this is the best operative method to be pursued.

Christopher Heath.

INNOMINATE ARTERY, The, commences at the highest point of the aortic arch, opposite the middle of the manubrium sterni, and ends opposite the upper part of the right sterno-clavicular articulation. Its length is from 1½ to 2 inches.

In front are the manubrium sterni and the sterno-clavicular articulation, separated from the arterial trunk by the origins of the sterno-hyoid and sterno-thyroid muscles above, and below by the left innominate vein. *Behind* is the trachea; to the *left* is the left common carotid artery; to the *right*, the pleura and the right innominate vein. No *branches* are given off from it normally.

LIGATION.—I. The patient is to be placed on the back, with the shoulders slightly raised on a pillow, the head well thrown back over the pillow and the face turned to the left side. The surgeon stands on the right side of the patient, an incision is commenced from the middle line over the trachea and three quarters of an inch above the sternum, and carried outwards parallel to, and half an inch above, the clavicle, as far as the outer border of the sterno-mastoid muscle. Another incision is made upwards, from the inner end of the first, along the anterior border of the sterno-mastoid muscle for three inches. The angular flap thus shaped exposes the sterno-mastoid at its origin. A director or the finger is first passed beneath the sternal, and then the clavicular, head of the muscle, and each is divided, the inner wholly, the outer for about three-quarters of its extent. Reflect the angular flap; search for the outer edges of the sterno-hyoid and sterno-thyroid muscles; pass the director beneath them, raise them and divide. Recognise and open the common carotid sheath, following the artery downwards with the finger, when the innominate will be reached. Pull the pneumogastric nerve and the internal jugular vein outwards and see the subclavian. Clear the innominate artery, as well as possible, from the pleura on the right and the veins in front. Pass the needle from right to left, avoiding carefully the pleura. The description here followed is mainly that given by Mott. II. Sédillot recommends an incision through the integuments along the interval between the sternal and clavicular origin of the sterno-mastoid muscle. It is possible, says Sédillot, when the muscular heads are well separated and the patient's head flexed, to raise the sterno-hyoid and sterno-thyroid muscles, and, cutting them through, to obtain a view of the vessels which would allow of ligature of the innominate, the first stage of the subclavian, the first part of the common carotid, or the vertebral artery.

Of sixteen recorded cases, all have proved fatal except one, in which the common carotid was tied at the same time, and the vertebral artery later for secondary hæmorrhage. Twice the artery has been cut down upon and exposed without a ligature being passed, but good has resulted simply from the manipulation. JAMES CANTLIE.

INNOMINATE BONE, Fracture of the. *See* PELVIS, Injuries of the.

INTERTRIGO. *See* ERYTHEMA.

INTESTINE, Resection of. *See* ENTERECTOMY; COLECTOMY.

INTESTINAL OBSTRUCTION.—The conditions which produce an obstruction in the bowels are numerous and varied. They depend upon many different mechanical circumstances, and are the outcome of diverse pathological changes. They can be most conveniently grouped and considered under the following headings :—

1. Strangulation by bands, &c., and through apertures. 2. Volvulus. 3. Intussusception. 4. Stricture. 5. Obstruction by tumours and foreign substances within the bowel. 6. Obstruction by the pressure of tumours, &c., external to the bowel. 7. Fæcal accumulation.

1. STRANGULATION BY BANDS, &C., AND THROUGH APERTURES.—Although many different anatomical conditions are met with under this general heading, yet the lesion to the gut, and the method of obstructing it, are practically the same in all the instances. No matter whether the involved loop of gut be ensnared beneath a false ligament, or a Meckel's diverticulum, or an omental band, or compressed by the margins of a normal or abnormal aperture, the intestine so obstructed is strangulated by precisely the same means that are concerned in a strangulated hernia. Indeed, this form of obstruction is practically that of an internal hernia, and the symptoms, and prognosis, and treatment, in the two varieties of obstruction, differ only on anatomical grounds.

The commonest method of strangulation that comes under the above heading is effected by *peritoneal false ligaments.* These ligaments are isolated adhesions, the result of local peritonitis. They are most commonly met with after the peritonitis attending inflammation of the cæcum, or of the connective tissue or viscera of the pelvis, and after that due to injury, to hernia, or to mesenteric gland disease. Adhesions, capable of producing strangulation, may indeed follow any form of peritonitis from which recovery is possible. Many of the adhesions formed during the progress of peritonitis no doubt disappear in time, others persist, and a few are apt to become elongated and cord-like from traction. Often only a single adhesion is found, and hence the term employed by Mr. Gay of 'the solitary band.' The obstructing band is usually narrow, slender, fibrous, and cord-like. Its length varies, and its attachments will depend upon the situation of the causative peritonitis. It is very common for the band to be attached by one extremity to the mesentery. In most instances, the adhesion is found to be stretched in front of a resisting surface, such as the posterior abdominal wall, the floor of the iliac fossa, or a surface of the mesentery, and beneath the arcade so formed a loop of intestine is strangulated. In other and rarer instances, the band is unusually long and forms a loop or noose, in which a knuckle of bowel becomes ensnared, and by which it is ultimately strangulated. In some of the recorded examples, the loop or noose formed has been of a very complicated character.

In another class of case, the band is formed by the omentum, and is called an *omental cord*. In these cases, a part of the free border of the great omentum has become adherent at some spot, and the portion so bound down has developed into a cord-like structure. The attachment of the omental ligament is usually to the parietes or viscera of the pelvis, to the peritoneum in the cæcal region, or to the margins of a hernial orifice. In some cases the whole of the omentum has been rolled up into a fan-shaped structure, the base of the fan being at the transverse colon, and its apex at the point of attachment of the epiploon. More usually, however, the adherent segment separates itself from the rest of the omentum. As a rule, the omental cords are larger, coarser, and of greater length than those last mentioned.

Strangulation by *Meckel's diverticulum* also comes under the above heading. The true or Meckel's diverticulum is due to the persistence, or incomplete obliteration, of the vitelline duct. The diverticulum is always single, and comes off from the ileum from one to three feet above the cæcum. It arises from that side of the bowel which is most remote from the attachment of the mesentery. It is tubular, and its walls have, in all points, the same structure as the small intestine. In its most complete condition, it appears as a tube passing from the ileum to the umbilicus. Much more frequently, however, it forms quite a short projection from the ileum, and, indeed, the average length of the diverticle is three inches. It may be free, or it may have acquired an attachment at its distal extremity. This is more usually to the umbilicus, and is commonly effected by means of a ligament, which comes off from the end of a short tubular diverticulum, and continues the process to the vicinity of the navel.

The end of the diverticle or the cord, which is often continued from its free extremity, may be found attached to other parts, such as the small intestine, the cæcum, and, very commonly, the mesentery. Sometimes, in the position of the diverticulum, no tubular process is found but only a fibrous cord. This cord may represent a greatly atrophied and imperfect diverticulum, or may be the remains of the omphalo-mesenteric vessels. When the diverticulum is free, its extremity may be rounded like that of a test-tube, or it may be tuberose or clubbed, from the development of a false or protrusion-diverticulum.

This abnormal process may cause obstruction in several ways. The adherent diverticulum may form an arcade beneath which a loop of intestine becomes strangulated, or when of good length, and especially when in great part ligamentous, it may form a noose in which a knuckle of bowel may be snared. On the other hand, when the process is free from attachment, and has a clubbed extremity, it may actually tie itself in a knot around the pedicle of a loop of bowel. The precise nature and mode of formation of these remarkable diverticular knots has been well described by Parise.

In the fourth class of case, the strangulating agent may be *a normal structure which has become abnormally attached*. Thus intestine has been found strangulated beneath an adherent vermiform appendix or Fallopian tube, beneath a fixed portion of the mesentery, and beneath the pedicle of an ovarian cyst.

In many cases belonging to the present class, a piece of bowel is strangulated through some *slit* or *aperture*. In the majority of the instances, the slit is found in the mesentery. Some of the mesenteric holes are due to injury, while others are congenital. The congenital apertures are round and regular, and are found in the mesentery of the lower end of the ileum. In other instances, the aperture is in the omentum, and here also it would appear that certain of these unusual holes are due to injury, while others are congenital. A loop of bowel has been strangulated by the margins of the foramen of Winslow, by a slit in the broad ligament of the uterus, and in the suspensory ligament of the liver; by the ring sometimes formed by adherent intestinal loops, by the slit left between two parallel bands of adhesion, and through apertures of like peculiar and rare character.

The general form of strangulation, now under notice, may concern any part of the intestinal canal that is capable of becoming strangulated. The lesion, however, almost invariably concerns the lesser bowel. In some few cases, a part of the colon has been involved, but such instances are quite exceptional. Of the small intestine, the segment most frequently involved is the terminal part of the ileum.

The amount of bowel implicated varies from the smallest knuckle to a mass of intestine measuring several feet. The average length of the involved coil, as gathered from the examination of a large number of recorded cases, is about fifteen inches.

2. Volvulus.—The term volvulus is applied to a condition where the intestine is so twisted that its lumen has become entirely occluded. In one form of volvulus, the bowel is twisted about its mesenteric axis, or even, in rare cases, upon its own axis; while in another form, two suitable coils of intestine are so intertwined or knotted together that obstruction is brought about. The first form of volvulus is comparatively common, the latter is very rare. Volvulus may concern the small intestine, the ascending colon and cæcum, or the sigmoid flexure. It is most commonly met with in the sigmoid flexure. Elsewhere it is exceptional. Indeed, it may be said that the usual form of volvulus is due to a twisting of the sigmoid flexure about its mesenteric axis, and that all other forms of twist are rare.

Volvulus of the Sigmoid Flexure.—The bowel, as has just been observed, is usually found to be twisted about its mesenteric axis. In a normal sigmoid flexure, especially when the loop has but a short meso-colon, volvulus of this kind is impossible. A certain arrangement of the gut is necessary before the twist can be produced. In the first place the sigmoid loop must be of considerable length; in the second place its meso-colon must be long and very narrow at its parietal attachment; and, thirdly, the two ends of the loop of bowel must be brought very close together. When these conditions are found, there exists a free and loose coil, with a narrow and fixed pedicle, around which it can, with great ease, be twisted. This arrangement of the sigmoid flexure is rarely met with except in the bodies of adults, and especially in those past middle life. There is evidence to show that it is most probably brought about by long-continued constipation.

When volvulus occurs, the loop is twisted around its mesenteric axis. The twist is sometimes from right to left, but it is more usually from left to right. When the volvulus has occurred, both ends of the loop are occluded, and the twist is soon rendered permanent. The heavy and loaded coil has no inherent power of righting itself; it soon becomes distended with gas, and this distension renders the volvulus irreducible. If the gas be evacuated, the distorted coil can probably be made to assume its normal position. The distension of the sigmoid loop in volvulus is often enormous. In some cases the involved coil has appeared to occupy almost the whole abdominal cavity. When the distension is moderate, the fundus of the twisted loop reaches the umbilicus; as the distension increases, it tends to move towards the right hypochondriac region, and, in extreme cases, the diaphragm may be pushed up by the dilated coil, and death be brought about by pressure upon the thoracic viscera. The involved loop is found to be intensely congested, and in the condition indeed of bowel in a strangulated hernia. If the volvulus be unrelieved, patches of gangrene appear upon the bowel, and spread rapidly. The colon, above the twist, is found much distended; its mucous membrane is often ulcerated, and such ulceration may lead to fatal perforation. Peritonitis is remarkably common in this form of obstruction. It begins on the involved coil, and then spreads over the rest of the serous membrane. It is rarely absent.

In the other form of volvulus of the flexure, the same anatomical conformation is found in the bowel as in the previous case, and, over or under the pedicle of the loop, a coil of small intestine has passed, and the loop and the coil have become so intertwined as to cause obstruction in both the segments of bowel involved.

Volvulus of the ascending Colon and Cæcum is met with under three aspects:—(1) The ascending colon may be twisted around its own axis. This form of obstruction is, without question, exceedingly rare. (2) The cæcum and ascending colon are together provided with an extensive meso-colon. The free and loose loop of bowel, so formed, may become twisted about its mesenteric axis, or may become intertwined with a suitable coil of the small intestine, just as in the case of the sigmoid flexure. (3) The cæcum is the subject of congenital malformation, and is found to be so bent upon itself, or so twisted about its long axis, that its lumen is wholly, or in part, occluded. The colon, in these cases, is often imperfectly formed, the ascending colon is absent, and the distorted cæcum found in the right hypochondriac region or about the umbilicus.

All these forms of volvulus are rare.

In *Volvulus of the Small Intestine*, as in that involving the sigmoid flexure, two forms of twist may be found. In the one, a loop of the small intestine is twisted about its own mesenteric axis. In the other, a suitable coil of the bowel is engaged in a volvulus with another suitable coil.

It would appear that volvulus is not met with in the small intestine when the anatomical condition of that bowel is in all respects normal. Sometimes, a few adhesions hold the gut down in such a way as to render an irreducible volvulus possible. In other instances, the two ends of a large coil of small intestine are brought together. In this way the coil or loop becomes, to some extent, separated from the rest of the intestine. It has a pedicle, and is in a position to enter into either of the two forms of volvulus. The bringing together of the two ends of the bowel in the loop may be due to some old mesenteric gland disease, or to some local peritonitis involving the mesentery. Volvulus of the small intestine most usually concerns the lower ileum. The involved segment of bowel becomes occluded at both ends, and much distension is produced.

3. Intussusception.—By an intussusception is understood the prolapse or turning of one part of the wall of the intestine into the lumen of an immediately adjoining part. It forms more than one-third of the whole number of cases of intestinal obstruction. When an intussusception is viewed in vertical section, it is found to be composed of six layers of intestine—three on either side of the central canal—all more or less parallel to one another. On horizontal section it shows three concentric rings of bowel. In whatever way the section is made, the arrangement of the layers is found to be such that mucous membrane is in contact with mucous membrane, and peritoneum with peritoneum. The external of the three layers is known as the intussuscipiens or sheath. The innermost cylinder is called the entering layer, and the middle one the returning layer. These two layers, taken together, form the intussusceptum.

There are three anatomical varieties of intussusception:—(1) enteric; (2) colic; and (3) ileo-cæcal. The enteric involve the small intestine, and especially the ileum and lower jejunum. They are usually quite short. The colic may be found in any part of the colon, but are most common in the descending colon and sigmoid flexure. They also seldom attain great length. There are two forms of invagination at the ileo-cæcal region, viz. the ileo-cæcal and the ileo-colic. In the former, the ileum and cæcum pass into the colon, preceded by the ileo-cæcal valve, which forms the apex or free extremity of the intussusceptum. This form may attain great size, so that the valve reaches the anus and projects beyond it. In the ileo-colic form, the end of the ileum is prolapsed through the ileo-cæcal valve. The valve and the cæcum remain, for a while at least, unmoved, and the ileum always forms the apex of the intussusceptum. If the invagination increases after the ileum ceases to become prolapsed, the cæcum and the colon become the subject of a secondary invagination. Leichtenstern expresses the relative frequency of these various forms by the following figures: Ileo-cæcal 44 p.c., enteric 30 p.c., colic 18 p.c., and ileo-colic 8 p.c.

In all forms of intussusception, except the ileo-colic, the invagination increases at the expense of the external layer only. Thus, supposing the end of the jejunum to be invaginated into the ileum. If the mass increase, it will do so solely at the expense of the ileum, and no more of the jejunum will actively enter the intussusception. It thus happens that the apex of the intussusception always remains the same, no matter to what length the invagination attains. In the ileo-colic form, the end of the ileum is prolapsed through the valve, and as the invagination increases, more and more ileum is protruded through the ileo-cæcal opening, while the sheath remains unchanged. When, for various reasons, no more ileum can become invaginated, then, if the tumour increase, the cæcum will be turned in, and after it the ascending colon, the intussusception now growing solely at the expense of the external layer or sheath.

The true or obstructive intussusception must be distinguished from a form of invagination, which is supposed to be due to disordered intestinal movements occurring during the act of dying. These 'intussusceptions of the dying' are always small, are most common in the small intestine, are usually multiple, are frequently retrograde, and are in all instances very readily reduced. They produce no symptoms, and cause, indeed, no material narrowing of the lumen of the bowel. The true intussusception is always descending, i.e. always moves in the direction of the anus. In a few instances a true ascending or retrograde invagination has been met with. Except under the rarest circumstances, the true or obstructive invagination is always single.

Some few cases have been reported of double and triple intussusceptions. In these cases an invagination forms, and then its sheath becomes itself the subject of invagination, so that a double intussusception is formed, composed of five layers instead of three. If the outer sheath of a double intussusception become in turn the seat of another invagination, a triple intussusception is produced, which will be found to be composed of seven layers.

The tumour generally has a somewhat curved outline, especially in the ileo-cæcal forms. This depends upon the traction on the mesentery, and the tumour will therefore be concave on the side to which the mesentery is attached. The traction of the mesentery also tends to make the aperture of the intussusceptum slit-like, and to pull it towards the mesenteric side of the sheath or receiving layer.

Some invaginations may exist for some length of time without the lumen of the involved bowel becoming occluded, and without any gross changes appearing in the layers of the distorted intestine. As a rule, however, the intussusceptum soon becomes engorged with blood and greatly swollen. From this engorgement, coupled with the constriction to which the neck of the intussusception is subjected, the inner and middle layers may soon find themselves in the condition of strangulated bowel. At first, the lumen of the intestine is comparatively free, but by slow degrees it becomes narrowed, and in time most usually becomes quite occluded. This occlusion is due mainly to the great swelling of the intussusceptum, and also to the curving of the tumour from the dragging upon the mesentery, and occasionally to the plugging of the canal with clots of blood. Another important change which is apt soon to take place in the intussusception is this—it becomes irreducible. This irreducibility may depend upon adhesions at the neck or between the opposed serous surfaces of the inner and middle layers, or it may be due to the great swelling of the intussusceptum; or to the presence of a polyp at its apex, or to some alteration in outline that the invagination has undergone, or—in the ileo-colic form—to the resistance offered by the ileo-cæcal valve. In many, and indeed in perhaps the majority of the cases, two or more of these factors in the production of irreducibility are found to be combined. The intussuscipiens seldom undergoes gross change. It may, however, become the seat of some local peritonitis, or become ulcerated, or even in rare cases gangrenous. With regard to the intussusceptum, it in time tends to become gangrenous. The gangrene is produced by the same conditions which foster it in strangulated hernia. The necrotic process may be limited to some portion of the intussusceptum, or the whole of that part of the invagination may perish *en masse*, and be discharged from the anus. It is by means of gangrene of the intussusceptum that an invagination may undergo spontaneous cure. By this process of elimination several feet of intestine have been separated and evacuated.

4. STRICTURE OF THE INTESTINE.—In stricture, there is a narrowing of the lumen of the bowel, due to changes in the coats of the bowel itself. It is convenient to divide all cases of stricture into two great classes, the cicatricial and the cancerous.

The Cicatricial Stricture depends upon the contracting of a cicatrix, consequent upon the loss of substance by ulceration or limited gangrene of the inner coats. The nature and extent of the stricture produced will obviously depend upon the situation and extent of the original loss of substance. In the majority of examples, the cicatricial stricture has followed upon some primary ulceration of the bowel. Dysenteric ulcers very often lead to stricture. These ulcers are usually met with in the lower parts of the colon, and become rarer as the cæcum is approached. They often cause extensive and very irregular contractions, and may lead to a severe form of stricture. The catarrhal ulcer—met with in acute and chronic catarrh—and the syphilitic ulcer may both be causes of stricture. The former is, as a rule, limited to the colon, the latter occurs most frequently in the rectum and the lower ileum. The peptic ulcer of the duodenum, which is said to be caused by the action of the gastric juice, may also lead to stenosis. Tubercular ulcers of the bowel are also frequent causes of stricture. They are most common about the lower ileum and the ileo-cæcal valve. It would appear that the ulcers due to typhoid fever never produce a very definite stricture of the bowel. In several instances, the loop of gut which has been involved in a strangulated hernia has become the seat of a stricture, the stenosis depending upon cicatrisation after ulceration or limited gangrene of the involved intestine. Certain cases also have been recorded, where a cicatricial stricture has been more or less distinctly traced to the effects of some injury to the bowel.

The Cancerous Stricture. Two forms of cancer are met with in the bowel, the primary and the secondary. It would appear that any form of carcinoma may lead to secondary deposits in the bowel, and those deposits will of course present the same type of structure as is possessed by the primary growth. With this form of carcinoma, surgery has little or no concern.

With regard to primary cancer of the bowel, there are strong reasons for believing that it is strictly limited to one form of carcinoma—the epithelial. There is no evidence of a substantial character to show that scirrhus or medullary cancer ever appears in the bowel as a primary growth.

Epithelioma usually produces very definite and well-defined circular strictures of the bowel. The outer surface of the bowel at the seat of stricture is often very sharply constricted, and presents an appearance as if a piece of cord had been tied around it. The deposit in the interior of the bowel is apt to assume an annular outline, and to be attended early in the case by ulceration. The ulcers have often a thickened, indurated, and everted edge which is very typical.

In any case of stricture, whether simple or cancerous, the intestine above the narrowed part becomes dilated and hypertrophied, and its mucous membrane the seat of ulceration. In stenoses of the colon, ulceration is very commonly met with in the cæcum, even in cases where the obstruction is situated at some distance from the caput coli. It very frequently happens that the ulcer above the obstruction leads to fatal perforation.

Cancerous strictures are much more common than cicatricial strictures, and the colon is much more frequently the seat of the stenosis than is the small intestine. Excluding the rectum, the commonest seat of stricture of the intestine is in the sigmoid flexure ; next in frequency comes the descending colon, and then the splenic and hepatic flexures. Indeed, so far as the colon is concerned, it may be said that strictures become gradually less and less frequent as one passes up the intestine from the sigmoid flexure. In not a few instances the stricture has involved the ileo-cæcal valve.

5. OBSTRUCTION BY TUMOURS AND FOREIGN SUBSTANCES.—The following *Innocent Tumours* are met with in the intestine :—Fibroma, fibro-myoma, lipoma, angioma, and adenoma. The last-named is the most common, the other growths are rare. The adenoma grows from the mucous membrane, and is composed of glandular tissue, of the kind found in Lieberkühn's follicles. These tumours nearly always assume a polypoid outline. When the supporting connective tissue of the mass is loose and lax, it receives the name of a soft polyp ; when it is more dense and fibrous, the tumour is called a firm or fibrous polyp, or papilloma.

Adenomata are most frequent in the rectum and colon, are most often met with in children, and are more usually multiple than single. After the colon, the lower end of the ileum is the most frequent seat of polypoid growths. Sometimes these growths may attain great size. They may cause obstruction by their great size or by their numbers, and not infrequently they lead to intussusception. In some cases the pedicle of the polyp has given way, and the mass has been discharged per anum.

Sarcomatous Tumours have been met with in the bowel, both as primary and secondary growths. They are usually of the spindle-celled variety. They only very rarely appear as polypi, and more commonly spread around the bowel, and then probably produce one form of what has been incorrectly called a cancerous stricture. In connection with Hodgkin's disease, immense masses of lympho-sarcoma have developed in the bowel from the adenoid tissue in the mucous membrane.

By a *Foreign Body*, as applied to the intestinal tract, is meant any substance that can resist the digestive action of the fluids of the stomach and bowels. These substances may be swallowed by accident or intent, and the victims are very often lunatics or hysterical individuals. Some of the foreign substances which are smooth and rounded, such as pebbles, coins, &c., may pass readily through the bowel, while irregular-shaped bodies, such as pieces of bone and porcelain, and plates carrying false teeth, are very apt to lodge in some part of the canal. The majority, however, of foreign bodies which are swallowed are in time passed by the anus. They may be retained for weeks or even months, and then be evacuated. If obstruction be produced, it most probably depends upon impaction of the foreign body in the lower ileum. The cæcum is another spot where such substances are very apt to lodge. The impacted body may excite ulceration of the bowel. This may lead to perforation and death, or may induce the formation of an abscess, upon the evacuation of which the foreign substance is discharged.

In many instances a *Gall Stone* has become impacted in the intestine, and has led to fatal obstruction. The stone, to cause obstruction, must be of unusually large size, and it is probable that, in every instance, the calculus has reached the bowel by direct ulceration between the gall-bladder and the duodenum. If the stone is able to pass the bile-duct, it will certainly be able to pass through the intestine. When impaction has taken place, the stone is usually found to be lodged in the lower ileum, and next in frequency in the duodenum or jejunum. Impacted gall-stones have induced fatal ulceration and gangrene of the bowel, and have led to the development of fæcal abscesses, through which they have been discharged. These biliary calculi may be retained for weeks or months without causing any symptoms, or, after severe symptoms of obstruction have been produced, they may be spontaneously evacuated.

Obstruction in the bowel may be produced by *Intestinal Calculi* or *Enteroliths.* Some of these concretions are composed of phosphatic deposits, which are usually found to be formed around a nucleus composed of some undigested substance. Such enteroliths are stone-like, are usually single, and of small size. Other enteroliths are of low specific gravity, are porous and sponge-like in texture. These are composed mainly of densely felted masses of vegetable fragments, mixed with calcareous and fæcal particles. To this class belongs the avenolith, or oat-stone, which is said to be met with occasionally in the intestines of those who live largely upon oatmeal. Other of these calculi are made up of hair and fibres, which the patient is in the habit of introducing into the mouth from time to time. Thus a large mass, composed of cocoa-nut fibres, has been found in the intestines of individuals working with that material. In other cases, the concretion is formed of insoluble mineral matters which have been swallowed as medicines. These enteroliths are usually composed of magnesia, and may be of great size. In one instance, it was found to be composed wholly of gum benzoin.

6. Obstruction by the pressure of Tumours, &c., external to the Bowel.—As instances of this form of obstruction may be cited—occlusion of the intestine by a retroverted or retroflexed uterus, especially when enlarged by pregnancy, occlusion by uterine and ovarian tumours, by large abscesses, by tumours of the kidney and other parts, by enlarged spleens, and by hydatid cysts, &c. In this form of obstruction, the rectum suffers the most frequently, and after it the sigmoid flexure, and the terminal coils of the ileum.

7. Fæcal Accumulation.—The morbid condition, which forms the basis of this form of obstruction, is an insufficiency in the forces that move the intestinal contents forward. This condition may pass on to absolute paralysis of a segment of the bowel, leading to complete arrest of the intestinal contents and symptoms of obstruction. In chronic constipation it can only be said that the peristaltic movements are feeble, and inadequate to produce the effects expected of them. In the condition known as 'ileus paralyticus,' or obstruction by fæcal masses, the constipation has led to absolute occlusion of the bowel, and a considerable portion of the intestine is incapable of any peristaltic movements. Fæcal matters collect in this segment, and form a species of plug, which even vigorous action in the bowel alone is not able to dislodge. The retained fæces become more and more solid by absorption of their fluid parts, and the contraction of the empty or less distended bowel below the accumulation adds to the obstruction. As the case progresses, the paralysed intestine becomes more and more distended, its muscular fibres are stretched and even ruptured, and the possibility of a restoration of peristaltic movement is rendered gradually more remote. The condition may be further complicated by the appearance of chronic peritonitis. The gut above the occlusion becomes dilated and hypertrophied, and its mucous membrane the frequent seat of ulceration ('stercoral ulcers.') It is in the cæcum especially that these ulcers are very apt to occur. This form of obstruction is practically limited to the colon, although it may involve the lower ileum. The parts in which the accumulation most often forms are the cæcun and the sigmoid flexure. The dilatation of the bowel above the obstruction often attains enormous proportions, and the amount of fæcal matter accommodated in the bowel in these cases may be very considerable.

Rare Forms of Obstruction.—Among the rarer forms of obstruction which are excluded from the above classification, may be mentioned the following:—Occlusion of the bowel by acute bending or kinking, due to traction upon an isolated adhesion or an adherent diverticulum; occlusion by means of adhesions that compress the gut, and that mat several of the coils together; and narrowing of the bowel from shrinking of the mesentery after inflammation.

The Symptoms of Obstruction.—From a clinical point of view intestinal obstruction may be conveniently divided into three classes:—1, acute obstruction; 2, chronic obstruction; and, 3, cases where symptoms of acute obstruction supervene upon those indicative of chronic obstruction.

1. In *Acute Obstruction* the patient is seized, more or less suddenly, with severe abdominal pains. The pain is of the nature of colic, and is usually constant, although liable to exacerbations. He vomits. The vomiting appears early, is copious, persistent, and in time very commonly stercoraceous. There is more or less absolute constipation, with some distension of the abdomen. There is collapse with great depression of strength, the temperature falls, the pulse becomes rapid and very feeble, the extremities are cold, the face is pinched and the eyes sunken, and the amount of urine is diminished.

2. In *Chronic Obstruction*, on the other hand, the onset is gradual, and the progress of the malady irregular. There are attacks of pain, which come on at first at long intervals, are often provoked by food, and are frequently ascribed to indigestion or colic. These attacks become more frequent, more severe, and of longer duration. They are attended with some vomiting and with constipation. The vomiting is probably slight and the constipation not absolute. Between these attacks the patient may feel fairly well, and suffer only from some abdominal distension, some irregularity of the bowels, with a sense of malaise and with loss of appetite. The attacks become more frequent and severe, the vomiting is more persistent, the constipation more pronounced, and the patient dies, exhausted and marasmic, and worn out by the pain, the continued vomiting, and the inability to take food. The abdomen in such cases may be very much distended, and the movements of the intestinal coils may be visible through the parietes.

3. In the *third class of case* the patient, after presenting for a variable period the evidences of chronic obstruction, succumbs at last to an acute attack. The course of acute obstruction is to be estimated by days, that of the chronic form by weeks and by months.

Before proceeding to the diagnosis of the various special pathological forms of obstruction, it will be convenient to analyse briefly some of the more conspicuous of the symptoms.

Collapse, as an early symptom, is seen only in cases of acute obstruction where the intestine is strangulated. It is due to the sudden lesion inflicted upon the peritoneal and intestinal nerves. The severity depends upon the rigour of the strangulation, the amount of bowel involved, and, to some extent, upon the part involved; for it is apt to be more marked when the active small intestine is involved, than when the more passive colon is the seat of the trouble. The collapse will be obviously influenced by the age and general condition of the patient. In some cases it may be very profound—as profound as the collapse of cholera.

The *Pain* depends, in the first instance, upon the damage inflicted upon the bowel by the strangulation, and, later on, upon the violent and irregular peristaltic movement which the obstruction excites. Pain due to the former cause will be more or less continuous, while that due to the latter will be paroxysmal and colicky. In acute cases, the initial pain is frequently referred to the region of the umbilicus, i.e. to the region of the solar plexus. A continuous pain—even though it present occasional exacerbations—usually indicates complete obstruction, while a distinctly intermittent pain is associated with an incomplete occlusion of the bowel. The early pain in obstruction cases is, as a rule, not attended by tenderness on pressure. This latter symptom is associated with engorgement of the bowel, with long-continued cramp in the intestinal muscle, or with the appearance of local or general peritonitis.

The *Vomiting*, which appears at the very commencement of an acute case, is no doubt due to the lesion inflicted upon the abdominal nerves. The vomiting, in the after-course of the case and in chronic cases, depends, for the most part, upon the obstruction. The bowel above the obstruction becomes distended, and peristaltic movements passing along it induce the backward axial current in the contents, whereby they are poured into the stomach. The persistent vomiting in intestinal obstruction does not require the theory of antiperistalsis to explain it. If the obstruction be at or above the middle of the ileum, the vomited matters cannot become stercoraceous, unless they have been long retained, when, from decomposition, they may acquire a feculent odour. An obstruction in the lower ileum, or in any part of the colon, may be associated with genuine stercoraceous vomiting.

The State of the Bowels will obviously be influenced by the nature and degree of the obstruction. It depends—in cases of partial occlusion—also to a great extent upon the fluid or solid condition of the intestinal contents. The constipation may, in some cases, be in great part due to reflex nerve-action. Thus, in acute strangulation of the small intestine, there may be absolute constipation from the very onset of the obstruction, although the bowel below the occlusion is well occupied by fæces. In intussusception there is—in at least the earlier stages of the malady—diarrhœa. Tenesmus is a marked symptom in cases of invagination involving the large intestine, and is met with also in obstructions that implicate the lower parts of the colon.

The State of the Abdomen.—When the obstruction is complete, meteorism develops. With an incomplete obstruction—especially when a little diarrhœa exists—the abdomen may be quite flat and even retracted. Meteorism is most marked and is earliest seen, when the colon is obstructed. In no form of intestinal occlusion is meteorism at once more sudden and more severe, than in volvulus of the sigmoid flexure. In occlusions of the upper jejunum and duodenum, the distension of the abdomen will be limited to the region of the stomach.

An abdominal tumour may be felt in the following cases:—intussusception, fæcal accumulation, cancer, certain neoplasms, such as lympho-sarcoma, and in some cases of obstruction by gall-stones, foreign bodies, and enteroliths. A number of coils of small intestine, matted together by adhesions, have formed a species of tumour, and a localised dulness on percussion has been caused by collapsed coils of the lesser bowel which have become grouped together below an obstruction.

Local tenderness may correspond to a congested loop of bowel, or may indicate local peritonitis.

The diminished amount of urine passed in many of the acuter cases, does not depend upon the seat of the obstruction, as was once urged, but upon its acuteness, and upon the extent of the damage inflicted upon the nervous system. It is rather one of the symptoms of collapse; it varies with the extent and degree of the collapse and the severity of the pain. In these cases, a marked increase in the amount of urine passed as a rule immediately attends the administration of a full dose of opium.

Differential Diagnosis.—1. The case is diagnosed to be one of *acute obstruction.* The trouble may, in such an instance, be due to—*A.* Strangulation by bands and through apertures, including strangulation by omental cords, by Meckel's diverticulum, by an adherent appendix, &c., strangulation through normal or abnormal slits or apertures, and all forms of internal hernia. *B.* To volvulus of the sigmoid flexure or—in rare cases—of other parts of the colon. *C.* To acute intussusception; and, *D,* To some forms of obstruction by gall-stones, foreign bodies, and enteroliths. *See Table* 1.

2. The case is diagnosed to be one of *chronic obstruction.* The trouble may, in such an instance, be due to—*A.* Stricture of the small intestine, including the many conditions in which the lesser bowel has its lumen partly occluded by compression, by bending, by obstructing substances or new growths. *B.* Stricture of the colon, including the many conditions in which the colon has its lumen partly occluded by compression, by bending, by obstructing substances, or new growths. *C.* Fæcal accumulations; and, *D,* Chronic intussusception. *See Table* 2.

3. The case is diagnosed to be one of *acute obstruction supervening upon chronic obstruction.* In such instances, a form of chronic obstruction exists, in which the lumen of the bowel is only partly occluded, and in which a *complete* occlusion is suddenly brought about. Thus fæcal accumulation may lead to acute symptoms when absolute obstruction is produced. Or a stricture may have become occluded by a sudden bending of the bowel, or by blocking of its lumen by a mass of fæces or of undigested food. Or, again, in chronic intussusception, the lumen of the bowel may become in like manner suddenly occluded, and acute symptoms be thus developed.

In all such cases the previous history of the patient forms the most important element in the diagnosis.

Treatment.—1. *Acute Obstruction.*

A. Strangulation by bands, &c., and through apertures, including the conditions named under the heading in the diagnosis.

The patient must, of course, be kept absolutely at rest. No food of any kind should be given; it merely aggravates the vomiting, and could not be digested even if retained. Ice may be given to suck.

If there be very severe pain with collapse, and greatly diminished excretion of urine, morphia may be administered hypodermically. It must be remembered that morphia can have no really curative effect in these cases, and that it is apt to mask the symptoms, and effect such apparent improvement as even to alter the clinical aspects of the case. Laparotomy offers the only prospect of cure. In this form of obstruction spontaneous relief, while not absolutely impossible, is yet excessively rare, much rarer than the relief of strangulated hernia by spontaneous means. The operation should be performed at once. The simple opening of the abdomen is not in itself a serious measure. The delay is, on the other hand, extremely serious. Laparotomy should be a first and not a last resource. It is as useless to temporise in these cases, as it would be to temporise in a case of strangulated hernia after taxis had failed. For the various details of the operation, and the mortality attending it, *see* LAPAROTOMY.

B. Volvulus of the sigmoid flexure. There is no evidence to show that spontaneous cure ever occurs in this acute affection, when the twist is complete and well-defined. Unless relieved, the condition would appear to be inevitably fatal. The remarks on rest and diet, made respecting the previous form of obstruction, apply equally to this form. Morphia may be administered hypodermically. It stills the peristaltic movements which appear to constantly disturb the involved bowel. In some cases, where the distension of the loop has been relieved, the volvulus has become untwisted. The rectum should be therefore emptied by an enema, and the distended loop punctured through the parietes. Failing relief from this means, left lumbar colotomy should be at once performed. Left inguinal colotomy would merely open the distorted loop, and not the bowel above the obstruction. Attempts to reduce the volvulus, through an incision in the anterior abdominal wall, are not likely to be attended with success. The loop is often of enormous dimensions, and, if untwisted, the volvulus will most probably re-form again.

C. Acute intussusception. No food should be administered, and the patient only be allowed to suck ice. Morphia or opium should be at once given. The drug allays peristaltic movement, and prevents the increase of the invagination. It puts the disturbed parts at rest, and in some few cases—when given early—would appear to have effected a cure. Failing this, forcible enemata should be given. They should be administered by means of a syphon, so that the water can enter the bowel under a steady and easily regulated pressure. If much pain be occasioned, the enema may be given while the patient is under the influence of an anæsthetic. In any case, before the enema is used, the intestinal movements should be stilled by opium. The injection should be retained for at least fifteen minutes. Some surgeons prefer to distend the bowel with air, using for the purpose a common bellows. A better instrument for the purpose, however, is Mr. Lund's inflator (*Lancet*, vol. i. 1883, p. 588). These measures are worthy of a patient trial, and have been followed with considerable success. They are likely to be most effective in quite recent cases. They would obviously be useless when once adhesions had formed, or the invagination had become irreducible for other reasons.

If these measures fail, laparotomy should be at once performed. It is true that acute intussusception may in time take on a chronic course; but the great majority of the patients die long before they can enter upon the chronic disease, and, moreover, the mortality in chronic intussusception is very high. The general mortality of intussusception is 70 per cent., and 80 per cent. of the patients die before the seventh day. In young children the mortality is terribly high. It is well known that spontaneous cure may take place by elimination of the gangrenous intussusceptum. But such elimination only occurs in 42 per cent. of all cases, and, of those in whom it occurs, there is a subsequent mortality of no less than 40 per cent. The prospects of spontaneous cure by gangrene are too uncertain to be relied upon. As soon as the means already mentioned have had a fair trial and have failed, laparotomy should be performed without delay. In the young it has been urged that the operation should be performed within the first twenty-four or forty-eight hours.

In performing laparotomy the invagination should be reduced when possible, but, failing reduction, the mass should be resected by either of the two methods described under ENTERECTOMY.

D. Acute obstruction by gall-stones, foreign bodies, &c. In several of these cases relief has attended the free administration of opium, followed, after a while, by copious and repeated enemata and gentle laxatives.

Failing relief from these means, there remains no treatment other than by laparotomy and extraction of the foreign body. If the gut at the seat of the impaction be sound, the incision made in its walls may be closed by sutures and the loop returned. If it be gangrenous, or much ulcerated or inflamed, an artificial anus should be established, which can be closed subsequently by a second operation.

TABLE I.—ACUTE OBSTRUCTION.

SYMPTOMS	STRANGULATION BY BANDS, &c., AND THROUGH APERTURES	VOLVULUS OF THE SIGMOID FLEXURE	ACUTE INTUSSUSCEPTION	ACUTE OBSTRUCTION BY GALL-STONES, &c.
SEX; AGE.	More common in males than females. Mostly in young adults. Rare after 40.	Males to females as 4 to 1. Very rare before 40. Most common between 40 and 60.	A little more common in males; mostly in the young. One-half of the cases are under the age of 10.	Gall-stones are much more common in females than males. Average age, 50 to 65.
PREVIOUS HISTORY.	History of previous peritonitis in 68 per cent.	History of long standing, chronic constipation.	Nothing of note.	Gall-stones may have been passed. History of hepaticolic. History of foreign bodies swallowed.
MODE OF ONSET.	Sudden.	Sudden.	Sudden.	Sudden.
PAIN.	Appears early; is very severe; is colicky and persistent; is often situate about the umbilicus.	Appears early. Is severe, but not so severe as in previous case. Is intermittent at first, and then continuous, with exacerbations. Is most felt about navel and region of sigmoid flexure.	Appears early. Is severe at first; then tends to subside. Is at first, usually, distinctly intermittent, then becomes continuous, with exacerbations. May be localised about a tumour.	Appears early. Is severe and continuous, with exacerbations.
VOMITING.	Appears early; is constant, copious, and very severe. In 60 per cent. becomes stercoraceous, on an average, on the fifth day. It gives no relief.	Appears less early, and is less marked and less severe than in previous case. Is often scanty. Is feculent in 15 per cent. It often gives much relief to patient.	Does not appear so early as in the two previous cases. In 8 per cent. there is no vomiting; is often scanty; is liable to great fluctuations; in 25 per cent. the vomiting becomes feculent, on an average, on the fifth day.	Appears early. Is often copious. May in time become stercoraceous.
CONSTIPATION.	Complete and absolute from the first. No discharge of blood from the anus.	Complete and absolute from the first. No discharge of blood from the anus.	Absolute constipation extremely rare; diarrhœa is the rule. In 80 per cent. a bloody discharge from the anus.	Complete from the first. No discharge of blood from the anus.
TENESMUS.	Absent.	Met with in 15 per cent.	Met with in 55 per cent.; is often very severe.	Absent.
PROSTRATION.	Marked. There is collapse, intense thirst, diminished urine.	Not so marked as in previous case. May be collapse and diminished urine. Often severe dyspnœa from distension of the abdomen.	Marked; often severe collapse in the young.	Marked, but seldom so pronounced as in the previous forms of obstruction.
ABDOMINAL PARIETES.	Flaccid, unless peritonitis has set in.	Soon become rigid, owing to early and almost constant appearance of local peritonitis.	Flaccid, unless peritonitis has set in.	Flaccid, unless peritonitis has set in.
METEORISM.	Slight. Seldom appears before the third day.	Appears early, increases rapidly, and becomes very extreme. It often causes displacement of the thoracic viscera.	Is rare, and, indeed, absent, except in cases associated with constipation.	Slight.
ABDOMINAL TUMOUR.	Tumours or limited areas of dulness, due to distended or strangled loops, are extremely rare. Coils of intestine are not visible through the parietes.	No tumour. Coils of intestine are not visible.	A definite tumour in 50 per cent.; is usually in the line of the colon. Is apt to change its place, to increase in size and density during attacks of pain, and to be the seat of tenderness; is dull on percussion. Is not felt over the hepatic or splenic flexures of colon. A tumour may be felt in the rectum, or the invagination may protrude from the anus. Coils of intestine not visible.	Large gall-stones and foreign bodies have in rare cases been felt through the parietes. Large enteroliths may form distinct and hard tumours.
AVERAGE DURATION BEFORE DEATH.	Five days.	Six days.	Of ultra-acute cases, 24 hours; of acute cases, 2 to 7 days; of sub-acute cases, 7 to 30 days.	Seven days.

Table II.—CHRONIC OBSTRUCTION.

Symptoms	Stricture and Stenoses of the Small Intestine	Stricture and Stenoses of the Large Intestine	Fæcal Accumulation	Chronic Intussusception
Sex; age.	Non-cancerous strictures occur about early middle life. Cancerous strictures are very rare before 40. Unaffected by sex.	The same.	More often in females than in males. In adults, often in lunatics, hypochondriacs, &c.	More often in males than females, and most common during active adult life.
Previous history.	In non-cancerous cases there may be a history of dysentery, tuberculosis, injury, hernia, &c.	The same.	History of long-continued and increasing constipation, with declining appetite, foul tongue, occasional nausea, feeling of languor and depression.	In 35 per cent. of the cases, begins suddenly and becomes after a while chronic; in other cases, commencement may be very insidious.
Course.	Very irregular. Acute attacks may appear from time to time, and one such attack may prove fatal. Symptoms often subside or disappear for a while.	The same.	The abdomen becomes gradually distended and the symptoms develop slowly and progressively.	Remarkable by its irregularity and fluctuations.
Pain.	Intermittent at first, with long intervals of freedom from pain. In time, the intervals become shorter and the attacks of pain longer. Attacks become more frequent and severe. Pain is usually increased by food, especially by indigestible food. When the obstruction is complete, the pain is continuous, with exacerbations.	General character of pain the same, but is less severe. Is as a rule not affected, or but indistinctly affected, by food.	Pain develops gradually. Is at first paroxysmal, then continuous, with exacerbations. At any time evidences of acute obstruction may appear.	Distinctly intermittent. Is of irregular appearance and intensity. Is seldom severe; is often quite insignificant.
Vomiting.	Nausea during earlier attacks of pain. Vomiting during the later and severer attacks. Is often provoked by food. In any case appears late. Is scanty and very rarely feculent except towards end of an acute obstructive attack.	General characters the same. Appears later; is scantier; is not provoked by food; is never feculent except after many days of absolute obstruction. May be entirely absent.	Appears late; is scanty and irregular in its occurrence; is only feculent after a considerable interval of entire obstruction.	Is marked in only 50 per cent. Is of irregular occurrence. Is most often associated with attacks of pain. May be induced or made worse by food. Feculent in 7 per cent. May be entirely absent.
State of bowels. Tenesmus	Constipation in 60 per cent. Constipation with diarrhœa in 40 per cent. Constipation absolute during acute attacks. No blood passed per anum. No tenesmus.	Constipation the rule. In cancer, diarrhœa, with constipation, is common. In cancer, blood per anum in 15 per cent. Tenesmus especially in cases with diarrhœa.	Pronounced and increasing constipation. No blood per anum. No tenesmus.	State of bowels varies greatly. Irregular, with sometimes a tendency to constipation, and more often to diarrhœa. Blood per anum in 50 per cent.; tenesmus in 13 per cent.
Meteorism	Absent except during obstructive attacks or with absolute constipation.	Often very pronounced, especially when constipation exists.	Is gradual, progressive, and often considerable.	Absent except during attacks of complete obstruction.
Tumour.	In non-malignant cases no tumour. In cancer a tumour in 30 per cent. of the cases. Coils of intestine in movement visible through the parietes.	In non-malignant cases no tumour. In cancer a tumour in 40 per cent. of the cases. Coils of intestine in movement visible through the parietes.	Tumour very usual. Is most often in cæcum or sigmoid flexure. Is firm; may be doughy; is often nodular; may be very large.	Invagination tumour in 50 per cent.; mass felt in rectum in 32 per cent.
General condition	Patient emaciates, especially in cancer cases. Is worn out by pain and digestive disturbances. May be collapsed during acute attacks.	The same.	Suffers seriously from the occasional obstructive attacks. General condition the same.	The same. Often dies of marasmus.
Duration.	Three to five months, or longer.	Five to six months, or longer.	Many months.	One to six months, or longer.

2. *Chronic Obstruction.*

A. Strictures and stenoses of the small intestine. In these cases, very special care should be devoted to the dieting of the patient. The food taken should be moderate in amount, should be taken in small quantities at a time, and should be composed only of the most digestible substances. The bowels should be kept properly open by gentle laxatives and repeated enemata. When the condition of the patient becomes more grave, relief may be afforded by enterotomy (*see* ENTEROTOMY); but permanent relief can only be obtained by resection. In simple stricture, in obstruction by innocent neoplasms, in stenoses which cannot be relieved by simpler means, and in epitheliomatous strictures of limited degree, and attended by limited gland-affection, enterectomy offers a means of permanent relief (*see* ENTERECTOMY). Occlusions, due to adhesions, may be treated by the division of the obstructing bands when they are not too extensive, and by enterotomy when the amount of bowel involved forbids the operation of resection.

B. Strictures and stenoses of the large intestine. In these cases, long-continued relief to the more distressing symptoms may be obtained by a careful system of dieting, and by the continued use of gentle aperients and enemata. The operative treatment, suitable for these forms of obstruction, is identical with that advocated in the preceding class of case, colotomy being substituted for enterotomy, and colectomy for the resection of the small intestine. In performing colotomy, it is important that the position of the stricture should be diagnosed, so that the gut be not opened below the seat of the obstruction. The great frequency with which stricture appears in the sigmoid flexure, and the increasing rarity of the affection as the cæcum is approached, should be borne in mind in speculating upon the position of the stenosis. *See* COLOTOMY; COLECTOMY.

C. Fæcal accumulation. The treatment of chronic constipation need not be here considered. The surgical treatment of this form of obstruction is concerned only with cases, where the occlusion has become complete and urgent symptoms have developed. In such cases aperients do more harm than good. Abdominal pain may be relieved by opium or belladonna and warm fomentations to the belly. A very limited diet of carefully-selected and digestible food should be enjoined. In the more active treatment, much good may be effected by the repeated use of copious enemata, and by the evacuation of the contents of the rectum—when that part of the bowel is blocked—by means of the scoop, in cases where enemata fail. Some surgeons advise injection of carbonic acid in this form of obstruction, while others have ascribed the relief obtained to the use of massage of the abdomen and electricity. If all these methods of treatment fail, and the symptoms persist and become so urgent as to threaten life, no alternative remains but to perform colotomy. This procedure is, however, very rarely demanded, and, when performed in these cases, must be regarded rather as a surgical calamity than as a recognised means of treatment.

D. Chronic intussusception. In the treatment of this affection, great attention must be paid to the dieting of the patient. In the most chronic cases, benefit has attended the use of laxatives and enemata. The benefit has been, however, of a temporary nature only. In less chronic cases, and especially in cases attended by pain and distinct intestinal colic, the use of opium is indicated as a palliative measure. Attempts may be made to reduce the invagination by enemata or insufflation. Such measures, however, are almost sure to be attended by failure. The only remaining means is laparotomy, with reduction of the intussusception, if possible, and resection of the mass if reduction be impossible. The extremely fatal character of chronic intussusception forms an urgent argument in favour of interference by operation. FREDERICK TREVES.

INTRAORBITAL ANEURISM. *See* ORBITAL ANEURISM.

INTRA-UTERINE FRACTURES may be produced in three different ways:—1. By external violence or contre-coup. 2. By abnormal muscular contraction in the fœtus or the uterine walls. 3. By injuries during parturition. They may be simple or compound, disunited or united at birth. From the protection afforded to the fœtus by the liquor amnii when the membranes are intact, and from the softness and elasticity of the bones before birth, fracture *in utero* must be of rare occurrence. But the bones are subject to rickets at a very early period, and to faulty ossification with deficiency of earthy material, and in the majority of the cases where fracture has been found, some condition of this kind will have rendered the bones unusually brittle or pliable.

1. There are many cases on record where fracture of one or more bones, and even compound fracture, has been found to exist at birth, which has evidently resulted from some external injury to the mother, generally from falls upon the abdomen. The fractures are often at the epiphyses, but not necessarily so. The following are some of the cases recorded as having occurred after distinct falls upon the uterus: Fracture of the lower end of the tibia; fracture of the lower third of the humerus, ununited; compound fracture of the left femur; fracture through the epiphysis, with separation and displacement forwards and outwards of the inner condyle of the femur; fracture of the middle of the shaft of the femur, from a fall seven weeks before the birth of a seven months' child—the child died twelve days old, and the broken ends were found overlapped and firmly united by callus; a child was born dead with several fractures, three weeks after a fall from a window; another with fracture of the cranial bones with depression, from a severe fall on the uterus; a fracture of the middle of the tibia, ascribed to a fall six weeks before birth—the bone was shortened and bent, the wound still existed at the seat of fracture, and there was callus round both tibia and fibula; a fracture of the left clavicle, with the history of a fall three months before—there was swelling and slight overlapping of the fractured ends; birth of a child four months after a severe fall, with oblique compound fracture of the right tibia and fibula—for some weeks the mother had pain, the uterus being wounded at each movement of the fœtus, there was union at birth, but shortening and wasting, and only three toes, the right arm had also suffered—it was smaller, and had only three fingers. Dr. Flecken gives a case of a powerful woman delivered of a strong, living, full-timed child. After expulsion of a large placenta, another compact fleshy placenta in partial connection with the former followed. The accompanying membranes contained a six months' fœtus, the body of which had been compressed so flat, that the broadest part of the cranial and thoracic regions did not exceed five lines. The bones of the cranium lay separated from each other, the nasal bones projected as sharp points, and the broken malar bone penetrated the skin. While in the sixth month of her pregnancy, the woman had fallen downstairs. When fractures take place at an early period, there is generally arrest of development in the limb affected. Fractures of the cranium are exceedingly rare.

2. Fractures from muscular contraction are generally associated with congenital rickets, or with a cartilaginous or very imperfectly ossified skeleton. They are often multiple. Dr. Barker records the case of a child, which lived only ten minutes, where there was fracture of humerus, radius, ulna, femur, tibia and fibula on both sides; some of the bones being fractured in several places. There was also absence of the frontal, parietal, and expanded portion of the occipital bones, the earthy matter being deficient and irregularly deposited. Dr. Davies gives a case of compound fracture of the femur, the lower fragment overlapping nearly an inch. The child grew to be a man with arrest of development, the limb being only a foot long. Mr. Murray's case, a seven months' child of a syphilitic mother, lived a few days only, the left humerus and left femur being fractured. There are many other cases.

3. The frontal and parietal are the only bones fractured and fissured by uterine contraction in the act of parturition. Defective ossification is usually present. The amount of injury to the vessels is proportionate to the extent of the fracture and the separation of the edges of the bone. In these cases, blood is generally extravasated beneath the periosteum and in the cellular tissue of the scalp. Also internal cephalhæmatoma may occur. Cases of fracture of these bones have been recorded by Dr. West, Dr. Gotz, and others, and there are a number of cases collected by Dr. Schwörer, of Freiburg. Amongst the latter there is one of a child still-born, received into his own hands at birth. The skin over the vertex was found swollen, and there was a large effusion of blood beneath it, especially over the right parietal bone. The bone was fissured in two places. Dr. Michaelis, of Kiel, reports a case of fracture of the right parietal bone in five places, where it came in contact during birth with an immovable coccyx. The head was much disfigured, and in the posterior third of the sagittal suture, where the parietal bones were firm and well-formed and the suture only two lines in width, were seen small livid portions of the longitudinal sinus forced between the bones. Dr. Busch had a case of fracture during birth, in consequence of ankylosis of the joints in the normal position in the uterus. The child was born dead.

The subject of fracture *in utero* is interesting from a medico-legal point of view, as attempts at destruction of the fœtus *in utero* have undoubtedly been made both by the mother and by another person. The points to be determined in such cases are—the nature of the fractures, the condition of the bones, the period of the injury as shown by the presence of callus, &c., and the character of the labour. It is important that the surgeon should be acquainted with the forms of fracture that may occur *in utero* and at birth, independently of any intended violence. They are usually more limited in extent than in criminal cases. No surgeon should give evidence in respect to fractures in the newly born without a full examination of all the limbs of the child, and a careful consideration of the above four points.

The treatment of intra-uterine fractures should take the form of carefully regulated pressure, re-fracture if necessary, and sometimes the division of tendons which maintain deformity. GEORGE COWELL.

INTUSSUSCEPTION. *See* INTESTINAL OBSTRUCTION.

INUNCTION OF MERCURY.—The inunction plan of treating syphilis, though it has of late been superseded to a considerable extent, in this country, by calomel fumigation, and improved methods of administering mercury internally, is certainly in many instances an invaluable mode of applying this agent. When applied forcibly to the unbroken skin, mercury is taken up by the cutaneous glands and hair-follicles, from whence, after a probable conversion into the bichloride, it is transmitted to the general circulation by the lymph-vessels. The usual mode of inunction is, to rub into the skin of a certain region from half a drachm to a drachm of mercurial ointment, and to repeat this daily until a decided effect has been produced on the system and on the course of the disease. This treatment, to prove effectual and safe, must be carried out patiently and industriously, and with strict attention to many small details. The patient should take repeated warm baths during the course, spend at least a quarter of an hour every night in rubbing in the ointment, avoid very carefully exposure to cold and damp, be very temperate as to diet and alcoholic drinks, and keep the mouth in a clean and healthy condition by the frequent use of washes containing chlorate of potash, iodine, or chlorine.

A change should be made every night in the region to which the ointment is applied, the most convenient and suitable parts being the inner surfaces of the thigh and arm, the front of the forearm and of the chest and abdomen. Hairy surfaces should be avoided, as the inunction of mercury is apt to cause some irritation of the hair-follicles. As the manifestations of syphilis subside, the treatment, if tolerated by the system, should be discontinued very gradually. This plan of introducing mercury into the system is usually more rapid than others, and, in many instances, is more efficacious. The whole system is gradually and equably affected, and the mercury does not exert any special and excessive action on the liver and stomach, so that the latter organ, as has been pointed out by Sigmund, is left free for the reception of medicinal agents which may co-operate in the cure or relieve complications. Inunction seems to be specially indicated in cases of acute syphilitic affection of such important organs as the brain, the eye, and the internal ear. This method, however, is sometimes attended with bad effects. The local application of the mercurial ointment may cause a troublesome and obstinate erythema, and even a pustular eruption. Profuse and exhausting perspirations, and also diarrhœa, occasionally interfere with the good effects of the treatment. The objection to the plan of inunction, that it is troublesome and uncleanly, may be overcome by the substitution for mercurial ointment of the oleate of mercury. W. JOHNSON SMITH.

IODOFORM, Surgical Uses of.—This substance, which is chemically allied to chloroform, and contains 96·7 per cent. of iodine, is obtained in the form of small flat yellow crystals. It was first introduced into use, in this country at all events, as an application to chancroids, which fact, taken in conjunction with its tell-tale odour, accounts for the prejudice which to some extent still exists against its use. Since that time, however, its utility has been so marked in a wide variety of cases that its early use is becoming forgotten; although even now attempts are made to disguise its unmistakable odour, which is repulsive to many. Various means have been recommended for this purpose, such as tincture of musk, Tonquin bean, Peruvian balsam. The writer has for some years prescribed an ointment containing ʒj. of iodoform, fʒss. of compound tincture of benzoin to the ℥j. of vaseline; in which form the odour is altered, though not altogether disguised. According to Vulpius, the most agreeable way of applying it is dissolved in collodion, which will take up 15 per cent. of the powder; or in equal parts of turpentine and absolute alcohol, which will take up 4 per cent.; in oil of lavender (7 per cent.), or oil of caraway (16 per cent.).

As before mentioned, it has been and still is used, extensively and most successfully, in the treatment of chancroids and their glandular complications. It appears to have not only an antiseptic, but a soothing action on these sores; and, applied in the form of fine powder, the sores having previously been lightly dried, the risk of auto-inoculation of neighbouring parts is much diminished, especially if followed by the application of collodion, as recommended by Mr. Walter Whitehead. Even in cases where a phagedænic action has set in, and in which, formerly, destruction of the sore with nitric acid would have been indicated, the writer has seen most marked and speedy benefit result from filling the sores with finely powdered iodoform, especially if the part has previously been cleaned with glycerine of carbolic acid. But the success which attended its use in such sores led to its use in the treatment of various foul ulcers and wounds, especially in subjects where there was a syphilitic or a strumous taint. Carbolic acid is, of course, a potent cleanser, but its prolonged use does not promote a healing action; and for this reason the writer had, before the introduction of iodoform, used a combination of tincture of iodine with carbolic acid lotion in the treatment of foul or of indolent wounds, and the action of that mixture much resembled that of the drug now under consideration, in not only purifying the wound, but in stimulating the formation of healthy granulations and producing a typical healthy sore. In sloughing or gangrenous wounds, such as bedsores, iodoform is most valuable. The simplest way of applying it is from an earthenware salt- or pepper-caster. The iodoform may be mixed with any dry powder, such as oxide of zinc or calcined magnesia, or it may be used unmixed; but it should be kept in a cool but dry place. Where it is required to apply the drug to a cavity, one of the various forms of insufflator must be used.

So far as the writer's personal observation extends, he has not met with any case where harm has arisen from its use in this way; but it is well to bear in mind the fact that some cases have been recorded in which alarming symptoms, and even fatal results, have followed the free application of iodoform. (See *British Medical Journal*, June 17 and August 26, 1882.) The symptoms of poisoning are fully described in the articles referred to; but the main feature has been more or less affection of the sensorium, varying from delirium to stupor, accompanied by pyrexia, with rapid pulse and varying elevation of temperature; the symptoms being relieved or removed as the wound was freed from iodoform. Iodoform-wool is an elegant dressing, which is now often used in place of, or in combination with, the Listerian dressings, and is free from any risk of causing constitutional disturbance. With regard to its antiseptic properties, the following observations by Sir J. Lister may be quoted:—'Iodoform, while volatile, is very slowly volatile, and at the same time so little soluble in the discharges that in these points of view it seems an admirable antiseptic; but it is by no means a potent agent in its action on micro-organisms. It is remarkable that iodoform has such an effect as it has in preventing putrefaction; but it is by no means a powerful germicide.'

The following are some of the uses to which iodoform is applied. Finely powdered, it is so unirritating that it has been dusted over the conjunctiva at the first onset of purulent conjunctivitis, and both at this and at subsequent stages it has been found of great benefit; and in the same manner it has been freely applied to the peritoneum after abdominal section. In the form of suppositories, made with cacao-butter, it is used in gonorrhœa, gleet, and in cancerous and other ulcerations of the cervix uteri. A 10 or 15 per cent. solution in collodion has been found a most beneficial application in erysipelas. Internally, iodoform has been given with apparent benefit for ulcer in the stomach, in doses of from three to five grains; also in cases of syphilis, cancer, and in some forms of neuralgia, but with questionable success. So far, its great use has appeared to be as a topical agent. CHAUNCY PUZEY.

IRIDECTOMY. — The operation of iridectomy may be required for various purposes, either for the relief of tension (*see* GLAUCOMA), for neutralising the effect of adhesions, or for the formation of an artificial pupil, through which the patient may obtain vision when the natural pupil is closed or in any way obstructed. When performed on account of adhesions, or for the relief of tension, the piece excised should be the central third of the upper half of the iris, so that the gap is covered by the upper lid, and is neither unsightly nor disturbing to vision. When performed for the sake of making an artificial pupil, the piece selected for excision must be that which will render the artificial pupil most useful. Generally speaking, this will be determined by the state of the cornea, which may be opaque or distorted over some part of its surface, when the surgeon will endeavour to place the new pupil behind the best remaining portion. When there is a choice of situations, an artificial pupil is most useful when it can be made in a direction inwards and a little downwards. Next, as situations of election, come directly inwards, directly downwards, downwards and outwards, and directly outwards, in the order in which they are mentioned. When the only clear portion of cornea is above the pupil, so that the upper lid would interfere with vision through the new opening, good results have been obtained by the subsequent division of all the recti muscles save the inferior, so as to get the upper part of the cornea drawn downwards towards the centre of the palpebral fissure. In operating for the relief of tension, it is necessary to remove the whole width of the iris, right up to its peripheral attachment; and it is best to pursue the same course when operating on account of adhesions. In making an artificial pupil, it is often desirable to leave the periphery, and to cut out a mere notch from the pupillary margin. A small opening affords better vision than a larger one, and exposure of the margin of the lens is apt to produce troublesome distortion of the retinal image, by reason of spherical aberration.

The knife required for an iridectomy will vary with the condition of the eye. When there is a good anterior chamber, so that the lens, iris, and cornea maintain their normal relations to each other, and still more when the anterior chamber is deepened, the ordinary lance-knife is the most convenient. It should not be too wide, and its edges should become parallel at about seven or eight millimètres from the point. When there is high tension, with advancement of the iris and lens, the latter would be in danger of being wounded by the lance-knife before this could penetrate to a sufficient depth to afford the required length of incision; and, in these circumstances, it is necessary to use either a linear cataract knife or a very narrow lance-knife. The other instruments necessary are—an elevator for lifting the upper lid, a fixation-hook or forceps, iris-forceps and scissors, a blunt probe or spatula, some lint, bits of fine sponge, cotton wool, and a bandage. The sponges should be perfectly clean, and moistened with some antiseptic solution—that known as 'Sanitas' being one of the most convenient for the purpose. The eye should be brought thoroughly under the influence of cocaine, and it must be borne in mind that states of high tension interfere with absorption, so that rather more time must be given to the cocaine than would otherwise be required. The best method of applying it is, probably, by the discs rather than by solution, and three discs, each containing the fiftieth of a grain, inserted at intervals of five minutes, will usually be sufficient to render the eye completely insensitive.

Anæsthesia being complete, and the patient suitably placed on a couch in a good light, with the plane of the face nearly horizontal, the surgeon lifts the upper lid with the elevator and commits it to an assistant. He then secures the globe by the hook or forceps, making his fixation close to the corneal margin, at a point opposite to the centre of his intended incision. If necessary, he slightly rotates the globe, imitating the action of the corresponding rectus muscle, but never lifts or pulls it, and simply holds it still, without pressure, when the desired position is attained. If the ordinary lance-knife has been selected, its point is placed on the conjunctiva, a little behind the corneal margin, in the centre of the intended incision, and is made to pierce the sclerotic and to enter the anterior chamber immediately in front of the iris, by a steady gentle thrust directed towards the centre of the eyeball. As soon as the point of the knife can be seen through the cornea, its direction must be changed, the handle being sloped somewhat backwards so as to direct the point forwards in a corresponding degree; and in this position it is pushed steadily on, the operator watching the opposite margin of the pupil to see that the point rides safely over it. Supposing the aqueous humour to be retained, the thrust of the knife should be continued until the incision is of sufficient magnitude; but, if the aqueous humour should escape prematurely, before an incision of sufficient length has been made, the forward thrust must be immediately checked, and the knife withdrawn, lest the lens should be wounded. If the incision is nearly large enough, it may be completed by lateral cutting with the edge of the knife, as it is being withdrawn; if not, it may be enlarged at one or both of its extremities, either by scissors, or by any small knife which has a blunt extremity and a cutting edge. For the relief of tension, the wound should not be less than six or eight millimètres, but for other purposes it may be less extensive.

When the anterior chamber is too shallow for the thrust of a lance-knife to be made with safety, the operator may either take a very narrow lance-knife, the so-called iriddesis knife, or a linear cataract knife. In using the iriddesis knife, fixation should be made at the corneal margin, close to the left-hand extremity of the intended incision. The knife should be carried into the eye close to the right of the fixation-forceps, pushed on in front of the iris until its point nearly reaches the pupillary margin, and then its right-hand edge should be made to cut laterally, against the traction of the forceps, until an incision of sufficient length is obtained. If a linear knife is used, its point must be placed at the outer extremity of the intended incision, and introduced into the anterior chamber nearly as far as the margin of the pupil, over which it must not pass for fear of wounding the lens. It may then either be brought up, so as to effect a counter puncture at the other extremity of the incision, and to divide the bridge of intervening tissue as in cataract extraction (*see* CATARACT) ; or it may be made to cut its way along, just outside the corneal margin, to the required extent, or until the escape of aqueous humour renders the presence of a sharp-pointed instrument in the anterior chamber dangerous. It is of the very first importance that the incision, however made, should be as smooth and clean as possible, and that its edges, whether in the conjunctiva or the sclerotic, should not be jagged or contused.

The section being satisfactorily completed, the eye may be freed from tears and blood by one of the morsels of moistened sponge. The patient is directed to look downwards, and then, if the iris has prolapsed, the surgeon has only to take hold of it with forceps and to perform the excision. If it has not prolapsed, the closed forceps must be passed into the anterior chamber, nearly to the margin of the pupil, and there suffered to expand to an extent proportionate to the size of the piece to be removed. They are then closed upon the iris as it rises between them, and the plait which is seized is drawn gently out of the eye. If the object is only to cut a notch, to serve as an artificial pupil, the first incision through the external tunics may be small, and the scissor-blades may be placed as close behind the forceps as possible, so that only the piece actually held by the latter may be taken out, and the rest suffered or coaxed to return into the anterior chamber. If the object is to relieve tension, the operator cuts in a different direction, close to or even within one extremity of the wound, and quite up to the ciliary margin of the iris. He then tears the piece still held by the forceps from its attachment, as far as the other extremity of the wound, holds it somewhat upon the stretch, and excises it within the lips of the wound as before. If any portion of iris remains entangled at either extremity, an attempt may be made to seize and snip it out, or it may be gently replaced by a small spatula, or caused to return by carefully managed friction. If it should resist these measures it must be left alone, and dealt with on a subsequent occasion. Any coagula between the edges of the incision should be carefully picked out by iris-forceps, and blood in the conjunctival sac removed by the point of a morsel of sponge. A compressive pad and bandage should be applied, and the patient sent to bed. By the third day, or sooner, the wound will usually be healed and the aqueous humour retained, but the blood poured out by the cut vessels of the iris may require a longer time for its absorption, and may keep up some degree of irritation until it is absorbed. During this period, the day should be spent in a dimly lighted room, the eyes should be kept entirely at rest, and the compressive bandage should be worn at night, or during recumbency in the daytime. As soon as the blood has disappeared and the irritation is diminishing, the patient may be suffered to go into the air in favourable weather. Any piece of iris, left incarcerated at either end of the cicatrix, will be itself liable to become a cause of iritis, and may be rendered harmless by being severed, by the thrust of a cutting needle, from the intra-ocular portion with which it is continuous. When an iridectomy has been perfectly performed, it will leave no trace behind except the coloboma which it occasions. The cicatrix of the external wound should after a time become invisible, being neither marked by incarcerated iris nor even stained by pigment.

For cases in which the iris is free and normal, and in which an artificial pupil is required in consequence of central nebula of the cornea, or of small laminar cataract, the writer several years ago devised a method of operating which he described, for want of a better name, as 'optical iridectomy,' and which he has now practised extensively with good results. The object is to cut out a small V-shaped notch from the margin of the pupil, the apex of this notch being directed towards the periphery of the iris. For this purpose, the eyeball being carefully fixed, a puncture may be made at the corneal margin with a narrow iridectomy knife, the blade of which should pass in front of the piece of iris to be excised. The knife should be withdrawn with the smallest possible escape of aqueous humour, and should be replaced by De Wecker's iridotomy scissors, which should be carried closed into the anterior chamber, until the blunt extremities of the blades almost reach the pupillary margin. They are then suffered to expand, and the escape of aqueous humour lifts a small plait of iris between their edges, which plait is excised as they are closed, and may be brought out of the chamber as they are withdrawn. If it should be left behind, as sometimes happens, it may be extracted by fine forceps. In order to protect the lens, the external wound must be immediately in front of the iris, and the scissors must be directed forwards in the anterior chamber. The operation is one of considerable nicety, and should hardly be attempted by anyone who has not had experience in the less difficult manipulations of ophthalmic surgery; but, for certain cases, it affords a better pupil than can be obtained in any other manner.

R. Brudenell Carter.

IRIS, Diseases of the.—In order to understand the diseases of the iris, the principles on which they should be treated, and the consequences which may follow from neglect or from mismanagement of them, it is necessary to remember the structure and functions of the part in which they occur. The iris is an approximately vertical curtain, attached at its outer margin to the ciliary body, interposed between the crystalline lens and the cornea, perforated by a central aperture, the pupil, which varies in diameter with the amount of light falling upon the eye, and largely composed of muscular fibres, some radiating, some circular, by the action of which the diameter of the pupil is controlled. Besides muscular fibres, it is abundantly supplied with nerves and blood-vessels, is covered by epithelium, and, on its posterior surface, by a dense layer of pigment. The physical conditions of its surfaces are analogous to those of serous membranes, and, like these, it is liable to pour out a plastic exudation when it becomes inflamed. The pupillary aperture admits the rays of light to the interior of the eye, and, by its variations in diameter, regulates the amount admitted. In the healthy state, it is exceedingly sensitive to variations in the amount of light, contracting and expanding very freely; but in various states of disease this freedom of movement is impaired or lost. Besides admitting light it preserves a communication between the anterior and posterior chambers of the eye, permitting free passage of fluid from the latter to the former, and thus, indirectly, affording to the fluid of the posterior chamber, and even to that of the vitreous body, access to the circumcorneal zone immediately in front of the iris, a region which has been called by recent investigators the 'filtration area,' and through which the chief transudation of fluid from the eye is now believed to occur. In moderately dilated states of the pupil, the anterior capsule of the crystalline lens is in contact with the pupillary margin, and the centre of the lens projects slightly through the opening; but, when the pupil is widely dilated, its margin is removed from contact with the lens by the curvature of the latter; a relation between the two structures which has an important application in practice.

Coloboma.—The iris is occasionally the seat of a malformation called 'coloboma'—i.e. deficiency—which leaves a gap in some part of its circumference. A coloboma is usually seen extending directly downwards from the pupil, which appears to be enlarged in this direction as if it had been enlarged by an iridectomy. When thus situated, the gap may usually be seen by the ophthalmoscope to extend through the choroid up to the margin of the optic nerve; and, in such cases, it is manifestly due to imperfect closure of the tissues during fœtal life. Less frequently, coloboma iridis is met with in other parts of the circle, when the choroid seldom participates in the defect, the nature of which is then less easily to be understood. Coloboma may be complete, extending through the whole thickness of the iris and up to the ciliary margin, or it may be incomplete in either particular, in some cases consisting merely of a deficiency of the anterior portion of the structure, so that it does not affect the deeper layers and the posterior pigment; in others being a mere notch, extending only part of the way from the pupillary towards the ciliary margin. In all its forms it is an unimportant condition, the worst significance of which is that it may be part of a generally imperfect development of the organ. The practitioner should be on his guard against mistaking it for the result of an operation. In young women with light irides it forms a conspicuous disfigurement; but it is, of course, irremediable.

Cysts and Tumours.—The iris is occasionally the seat of cysts, which are usually congenital, although they may for a long time be so small as to escape notice, and of morbid growths, chiefly either sarcomatous or gummatous tumours. The last-named, of course, require only constitutional treatment as parts of the general syphilitic affection; but both cysts and sarcomata, or tumours of any other kind, should, as a rule, be removed, together with the whole of the portion of iris with which they are connected. In such cases, there will sometimes be a difficulty in making the preliminary incision into the anterior chamber without wounding the cyst or other morbid growth; but this difficulty may be overcome by making two punctures simultaneously, with two very narrow knives, one of which should be introduced on either side of the growth. It will then be possible to introduce a Weber's probe-pointed lacrymal knife through one puncture, and to bring it out through the other, when, the back of the blade being towards the growth, the edge may be employed to divide the bridge between the two punctures. Various attempts have been made to treat cysts by something short of complete excision; as, by excising only the anterior wall, or by free laceration with cataract needles; but these devices have not been followed by a sufficient measure of success to encourage repetition. In several instances acute inflammation has been set up, and the eye either destroyed or greatly injured. For tumours, it is hardly necessary to say, complete removal is the only course, and, until the tumour is in the hands of the surgeon, it will seldom be possible to speak with certainty of its precise nature, or of the chances of recurrence to which the patient may be exposed.

IRITIS.—The disease of the iris which demands most attention is inflammation. Iritis is a common affection, liable to occur in both sexes and at all periods of life. Its possible causes are various; its more common causes are injury, some dyscrasia, such as syphilis or rheumatism, and perhaps some forms of perverted innervation. It is often referred to an exciting cause, such as overwork of the eye, exposure to cold, to glare, to irritating particles or vapours; but these conditions, when not sufficiently intense to be included within the general term 'injury,' probably owe their efficacy to some predisposing influence. Iritis is seen under two chief forms—the plastic and the serous. In plastic iritis there is a considerable exudation of lymph, which sometimes forms nodules on the surface of the membrane or at the margin of the pupil, and which frequently produces adhesions of the iris to the anterior capsule of the lens. In serous iritis the effusion consists of turbid fluid rather than of lymph, and the adhesions, if formed, are smaller and less resistant; but the fluid often augments the tension of the eye-ball in a decided manner, and exudation is often deposited upon the inner surface of the cornea in a cloud composed of minute dots, which are usually arranged in the form of a pyramid, with its apex over the pupil, and its base at the margin of the cornea.

Plastic Iritis.—The first *symptoms* by which plastic iritis can be distinctly recognised are four in number, and they are usually all present together. They are: (1) A slight diminution of the ordinary lustre of the iris, with some apparent change in its colour; (2) some degree of impairment of the mobility of the pupil; (3) some impairment of vision; (4) a slight zone of peri-corneal sclerotic congestion. If only one eye is affected, the other must be used as a standard of comparison; and, in testing the mobility of the pupil, the sound eye must be screened from light and the affected eye must be alternately shaded and exposed without being touched. *See* EYE, General Examination of the.

A deceptive resemblance to iritis may occasionally be produced by some affections of the cornea; for a hazy cornea may at the same time conceal the lustre of the iris, diminish its mobility by diminishing the quantity of light which reaches it, impair vision, and be attended by sclerotic congestion. The removal of any doubt, hence arising, may be obtained by the application of a drop of solution of atropia, which for this purpose should not be of lower strength than two grains of the neutral sulphate to an ounce of distilled water. If this fully dilates the pupil within the customary time, half an hour or so, and if the dilated pupil preserves a circular outline, iritis is certainly not present. In actual iritis, generally speaking, even when the patient is seen for the first time, one or more points of adhesion will have formed; and atropia, if it dilates the pupil at all, will dilate it into an irregular outline, which at once renders the adhesions conspicuous. If more time has elapsed since the commencement of the disease, and if the case were either severe originally, or has been rendered so by maltreatment, the pupil may be wholly immovable, either universally adherent or totally insensible to the action of atropia; the surface of the iris may present blood-vessels visible to the naked eye; the anterior chamber may be more or less filled with lymph, partly adherent to the iris, partly diffused through the aqueous humour, and sometimes passing into a purulent condition; vision may be reduced to quantitative perception of light, and the ocular conjunctiva may be intensely congested.

Pain is a very uncertain symptom. It is nearly always present when there is increased tension; but, in other cases, it seems to depend more on the condition of the patient than upon that of the eye. When there is pain, there is nearly always constitutional disturbance, either feverishness and a loaded tongue, with disordered secretions, or else a generally neurotic state, the pain ramifying more or less through the different branches of the fifth nerve, and often assuming an intermittent or paroxysmal character.

Intolerance of light is seldom present; but, when present in any marked degree, it is a symptom of grave import. It indicates at least a tendency on the part of the ciliary body to participate in the morbid action, and it gives to the whole case an entirely new significance.

In the *treatment* of iritis, in all its forms and stages, the first principle to be borne in mind, and to be acted upon in every case without exception, is a negative one. It is to do no mischief; and the only way to avoid doing mischief is to avoid all irritating local applications. In a case of commencing iritis, the application to the eye of a drop of a zinc or silver lotion will stimulate the disease into a state of intensity, which is hardly seen under any other conditions.

In plastic iritis of only moderate severity, which has not been aggravated by any irritant, the tendency is towards recovery; and the indications of treatment are two—first, not to counteract this tendency; next, to prevent the formation of adhesions, or to overcome them if they have formed already. For the fulfilment of the first indication it is necessary to give both eyes complete functional rest, and to protect them from changes of temperature, from irritants, and from glare. The fulfilment of the second indication is to be accomplished only by atropia or some kindred preparation; and hence the effectual use of atropia is the cardinal point in the early treatment of plastic iritis, the one thing which should never be omitted, save in the excessively rare cases in which it is found to act as a direct irritant to the conjunctiva. The margin of the pupil, as already stated, when the opening is of its ordinary diameter, rests in contact with the anterior surface of the crystalline lens. In this position, the effusion of lymph is followed by the immediate adhesion of the structures between which it is interposed. But full dilatation of the pupil removes its margin from contact with the lens, in consequence of the receding curvature of the peripheral parts of the latter. The anterior capsule is then separated from the iris by a film of aqueous humour, into which the lymph projects without becoming adherent, or through which it is diffused. Complete dilatation of the pupil, therefore, presents an insuperable physical obstacle to the formation of adhesions; and, as soon as the pupil is completely dilated, there is nothing more to do than to maintain the dilatation, and the iritis will die out harmlessly.

In order to dilate the pupil, when declared iritis exists, it is best to use a 4-grain solution of sulphate of atropia, and to place a drop within the conjunctival sac every four hours. If the iritis has existed twenty-four hours or more, the atropia will be likely to produce only irregular dilatation, the pupil expanding fully in some directions, while its margin is already fixed at certain points by adhesions. The atropia being continued, recent adhesions will in many cases give way, and when they do so the dilatation becomes complete. The atropia being still continued, the eye recovers in the course of a few days, and the pupil may then be suffered to return to its normal diameter. Complete dilatation is always attended by much relief to the symptoms previously complained of by the patient; but, if atropia is laid aside as soon as complete dilatation is produced, the improvement will often be only temporary. The pupil contracts again, the hyperæmia continues or increases, more lymph is poured out, and adhesions recur. In order to avoid such recurrence, it will usually be sufficient to continue the application of atropia with diminished frequency, as by a single drop night and morning, until all unusual vascularity has disappeared, until the media are clear, and until natural vision, save for the action of the atropia, is restored. When recovery is apparently complete, the atropia may be laid aside; but the eye must be carefully watched during the first few days, and the slightest blush of renewed congestion would call for an immediate return to the remedy.

When plastic iritis is of a high degree of original severity, or when it has been aggravated by improper treatment, or even when it has been suffered to exist for some days unchecked, a state is produced in which atropia fails to exert its customary influence. Either the dilatator muscle is paralysed by the inflammation, or the greater part of the iris is adherent, or these conditions co-exist. The adhesions remain unaffected, and the intermediate portions of the pupil will only dilate partially and sluggishly, if at all, showing that the muscular fibres act only imperfectly, even where the margin is free. In such conditions, the demand for mercury is imperative; and its constitutional action must be obtained as rapidly as prudent administration will allow. It may therefore be said, as a rule, that it is sufficient at first to prescribe atropia solution for a case of iritis, which is at once mild and recent. But if, when the patient is first seen, the attack has been running on for a day or two, and is even moderately severe, it is better to prescribe mercury as well as atropia, giving perhaps two grains of blue-pill twice a day. In forty-eight hours, if the pupil is well dilated, the mercury may be laid aside; but, if the pupil has resisted dilatation, the mercury must be pushed, with the knowledge that the quantity already taken has laid the foundation of the effect which it is desired to produce. This effect should not exceed the formation of the slightest mercurial line upon the gums; and it should be maintained until resolution of the inflammation is accomplished. Improvement usually commences almost simultaneously with the first appearance of the mercurial line; and absorption of the effused lymph often proceeds with great rapidity. As the lymph disappears, the pupil yields more and more to the atropia, and, in favourable cases, rupture of all the adhesions may be produced.

The influence exerted upon iritis by mercury, and the necessity for administering it in certain cases, seem to be essentially independent of the syphilitic or non-syphilitic character of the affection. A patient who has iritis may also have syphilis, and may require mercury on account of that syphilis; but, speaking with reference to the iritis alone, the writer is not accustomed even to take into consideration, as a question bearing upon treatment, whether the iritis is syphilitic or not, but accepts resistance to atropia as a sufficient proof that mercury is needed.

It sometimes happens that iritis is attended, from the first, by an unusually active degree of vascular excitement. The face will be somewhat flushed, the eyelids hot, the temporal pulse increased in fulness and force. In such circumstances the action of atropia will be resisted, but it does not follow that mercury will be required. Before prescribing it, an endeavour should be made to subdue the vascular excitement, and, if this can be accomplished, complete dilatation of the pupil will often follow. A case might occur in which it would be proper to take blood from the arm; but two or three leeches to the temple, near the margin of the orbit, will generally be sufficient. Whenever there is evidence of active congestion, coupled with resistance to atropia, some form of depletion should precede the administration of mercury, and, if the pupil then become dilated, should supersede it. If there were any strong reason for abstaining from depletion, a minim or two of tincture of aconite might be given every fifteen minutes, until a manifest diminution of vascular excitement was produced.

When iritis is attended by pain, this may arise from either of two widely different causes, and may assume either of two widely different characters. It may be the pain of hyperæsthesia, of nervous exaltation or irritation, or it may be the pain of tension, due to the stretching of the ocular tunics by increased secretion within. The former is usually more or less neuralgic and paroxysmal, the latter is usually described as a permanent sensation of fulness, aching, stretching, or weight. But verbal descriptions of pain have no common measure; and, whenever pain is experienced in iritis, the state of tension of the eyeball must be carefully and frequently examined, and any decided increase must be diminished by paracentesis or iridectomy, according to circumstances, which will presently be considered. Pain of an irritative or neuralgic character must be subdued; for it may be laid down as a general principle that improvement is not to be expected while it continues. Until recently, the best way of subduing it was by the hypodermic injection of morphia; but the application of cocaine to the conjunctiva furnishes a still more valuable resource. A single cocaine disc, containing the fiftieth of a grain, will often afford relief in a few minutes, and may be repeated, without any countervailing disadvantage, whenever a return of pain may render it desirable.

The pain of increased tension is perhaps most frequent in 'serous' iritis, but it occurs also in the plastic variety. It calls for the prompt evacuation of the contents of the anterior chamber. For this purpose, the eye being rendered insensitive by cocaine, a broad cutting-needle or a cataract-knife, or, in default of these, almost any sharp-pointed cutting instrument, should be thrust into the anterior chamber immediately in front of the iris, and withdrawn. A fine probe may then be introduced through the opening, and used to press back the posterior edge of the puncture until all the fluid contained in the anterior chamber has escaped. It is not safe to use the cutting instrument for the purpose of evacuating the fluid, inasmuch as the iris, or even the lens, might easily be wounded against its point. When carefully performed the little operation is free from risk, and may be repeated as often as the tension is restored, although a single puncture will frequently be sufficient. The evacuated fluid is usually yellow and albuminous, and its escape restores the natural colour of the iris, showing that the change in this respect, which is almost universal in iritis, is due to the change in the medium through which the surface of the membrane is seen.

By the foregoing means, by atropia, with or without mercury, and with or without local depletion and paracentesis, nearly every case of plastic iritis may be conducted to a successful issue, so far, at least, as the subsidence of the inflammation and the restoration of good vision are concerned. In some cases, however, adhesions remain, and these cases cannot be said to be cured. In a few instances no further mischief may ensue, but in the majority the adhesions will become exciting causes of recurrent inflammation. As a rule, the eye in which iritis has left a partially adherent pupil will suffer from iritis again. The function of the muscles of the iris is to regulate the diameter of the pupil in response to every variation in the quantity of light which falls upon it; and an adhesion is a perpetual obstacle to the discharge of this function, and serves to check the variation of the pupil abruptly, whenever it passes a certain limit. As an almost necessary consequence, the adhesion becomes a source of irritation, and maintains a condition of preparedness to inflame. Accidental injury, overwork, or general disorder of the health, finds in the affected iris a part in which the natural vital resistance of the tissues is diminished, and in which morbid action is readily set up. The second attack of iritis, in such circumstances, falls upon an eye in which there is a mechanical impediment to the dilatation of the pupil, so that the parts of its margin adjacent to the existing adhesions must remain in contact with the capsule of the lens, and are thus liable to be rendered adherent themselves. Under judicious treatment, the second attack will generally subside, but not until it has added to the extent of the adhesion left behind by the first.

When one recurrence has occurred, others are almost sure to follow; and each will bind down more and more of the pupillary margin, until at last this is rendered entirely adherent, and there is no longer any communication between the anterior and the posterior chambers. The resulting state is called, not very felicitously, 'exclusion of the pupil,' and, before it is produced, there is usually a good deal of lymph deposited over the whole of the anterior pole of the lens, which lymph, as it undergoes shrinkage, drags the pupillary margin together, and assists in closing the opening. As long as the pupil is not entirely 'excluded,' as long as there is an aperture even the size of a pinhole, the case may be amenable to treatment; but as soon as the pupil is entirely closed, a fresh series of changes will commence. The quantity of fluid contained within the eye, is regulated by the preservation of a certain balance between the internal secretion and the exhalation which occurs chiefly at the angle of the anterior chamber. When once the pupil is closed, the effect of this exhalation no longer extends to the regions posterior to the iris; and the fluids of the posterior and vitreous chambers, although continually increased by fresh secretion, have no longer any sufficient outlet, and hence rapidly increase the tension of the posterior parts of the eye. They push forward the peripheral or non-adherent zone of the iris, and thus afford evidence of the completeness of the 'exclusion,' which may be known to exist whenever this peripheral zone is stretched, convex, and prominent, while the central or pupillary portion of the iris is comparatively flattened or receding. In such circumstances all the tissues of the eye, probably already damaged by repeated inflammation, undergo speedy atrophy. The iris tissue wastes, the vitreous body becomes fluid, the lens becomes opaque and often calcareous, and the retina perishes in the common ruin. There can be no more hopelessly spoiled organ than an eye in which recurrent iritis has been suffered to run its course unchecked, and to produce its ordinary consequences.

It is therefore a matter of primary importance, in dealing with a first attack of iritis, to prevent the formation of adhesions, and it should never be forgotten that this can be done, with a very near approach to certainty, by the early and efficient use of atropia. When, from any cause, the atropia has not been efficiently used in time, or when its action has been resisted, and the inflammation subsides leaving an adhesion behind, such a condition must not be accepted as a recovery. In the first place, an endeavour should be made, after the subsidence of the inflammation, to detach the adhesion, or, if it cannot be detached, to stretch it, by the continued use of atropia. Very considerable adhesions will sometimes yield if the pupil is kept fully dilated, and if mercury is cautiously administered. If an adhesion, without being ruptured or detached, can even be stretched into a linear band, it may afford the iris sufficient freedom of play; and it may generally be assumed that the action of atropia and mercury cannot be profitably continued for more than about a month. The condition which remains at the end of that time may safely be regarded as an established one, or at least as incapable of being altered except by operative interference.

The effect of adhesions in producing secondary iritis may probably depend somewhat upon their precise position with regard to nerve-filaments, upon their extent, and upon personal peculiarities. As these are uncertain elements, and as, in a few cases, secondary iritis does not occur, no operative interference with the adhesions left behind by a first attack can, generally speaking, be recommended. The exceptions to this rule are furnished by patients who are about to undertake long voyages, or to travel in countries where they might not, in the event of a recurrence, be within reach of skilled treatment. But after a second attack of iritis has occurred, there is no longer much prospect of escape from others, and the conditions previously existing become wholly changed. If successive recurrences are permitted, it is probable that total and incurable blindness will be produced in the course of a few years; and the only way in which this danger can be obviated is by the detachment of the adhesions or by the performance of iridectomy.

Detachment of adhesions may be accomplished in two ways: either by the operation of Mr. Streatfeild, or by that of Dr. Passavant.

Mr. Streatfeild's operation, to which he has given the name of 'corelysis,' is performed by making with a cutting-needle a puncture through the cornea, about midway between its summit and its margin, at a point opposite to the adhesion to be detached. The 'corelysis hook,' a fine and narrow spatula with a notch on one side, is introduced through the puncture, carried between the lens and iris, and so manœuvred as to engage the adhesion in the notch and to break or cut it by traction across the pupil towards the puncture. Dr. Passavant's operation consists in detaching the adhesions by forceps traction, in a direction towards the ciliary region instead of away from it. He makes a small incision with an iridectomy knife in the corneo-scleral junction, on the same side as the adhesion, and, so to speak, behind it. He then introduces forceps like common iris forceps, but without sharp teeth, so that they hold without wounding; seizes with them a fold of iris just behind the adhesion, and draws it towards the wound, as if he were going to draw it out for an iridectomy. As soon as he sees the adhesion yield he ceases his traction, suffers the forceps to expand, and withdraws them empty. If a portion of iris should prolapse through the wound, it is replaced by gentle rotatory friction through the closed lids, or, if that should fail of effect, by the extremity of a blunt probe. The eye, after either operation, is bandaged and treated in the ordinary manner, and is brought as soon as possible under the full influence of atropia, in order to dilate the pupil and to prevent reunion of the adhesion.

The writer has practised both these operations frequently, and has been induced by experience to abandon that of Dr. Passavant entirely, and to reserve that of Mr. Streatfeild for cases in which there is only one adhesion, or two placed near together, and in which there are strong cosmetic reasons for avoiding iridectomy. Upon a pretty girl with blue irides and well-opened eyes, to whom an iridectomy, even at the upper part of the circle, would be a serious blemish, it would be legitimate to perform corelysis, but hardly in any other circumstances. It is a fault common to both the operations that they must be repeated nearly as often as there are adhesions to be dealt with. When two adhesions are close together, they may be torn through by forceps traction from a point between them, or may be included in one sweep of the corelysis hook; but, if they are too far apart for either of these procedures, they will generally require distinct operations, separated by a sufficient interval of time. For every adhesion there must be a point from which the traction ought to be made in order to be most efficacious; and if a second or even a third adhesion can be reached from the original wound, yet the hook or forceps will act at a mechanical disadvantage in detaching it. Moreover, however fully the eye may have been brought under the influence of atropia, the evacuation of the aqueous humour, and the irritation of the iris by instruments, will produce a contraction of the pupil by which the exact position of any remaining adhesions will be concealed; and it would not be prudent to make casts with a hook in the mere hope of catching something, or to pinch up iris here and there without good reason. A still more serious fault, also common to both operations, is that the adhesions, when detached, sometimes reunite while the external wound is healing, so that the objects of the operation are defeated. Lastly, in some cases, opacity of the crystalline lens has followed the traction. If this had only occurred after Mr. Streatfeild's method, it might be supposed that the capsule had been injured by the hook. But it has occurred also after the use of the forceps, which were separated from the lens by the iris, and never entered the region of the pupil at all; so that it is manifest that the capsule itself may sometimes tear, instead of, or together with, the adventitious band. Dr. Passavant's method, moreover, labours under a disadvantage which is all its own—namely, that an adhesion is liable to be formed between the cicatrix of the wound of entrance and the peripheral part of the iris. Such an adhesion might be both concealed and unsuspected; but it would not be any the less likely to occasion future attacks of inflammation. It may be admitted that with Mr. Streatfeild's hook, especially if the notch is made large enough to receive a cutting edge, a single adhesion may often be safely and certainly divided, with only a small chance that it will reunite. But when the adhesions are multiple, the chances of reunion are greatly increased, and the risks of producing new peripheral adhesions or opacity of the crystalline lens are too serious to be disregarded.

From the foregoing objections the remaining resource, iridectomy, is wholly free, and it has the additional advantage of being of almost certain efficacy in preventing the recurrence of iritis. Even if it should fail in this, it will at least prevent occlusion of the pupil by any ordinary attacks, inasmuch as a large gap in the peripheral portion of the membrane is hardly ever filled up and dragged together by lymph, except when the operation is performed in the course of irido-choroiditis, and fails to arrest it. It matters little what part of the iris is removed, and it is not at all necessary, nor in any way specially advantageous, to remove the adherent portions. The effect seems to be produced by breaking the continuity of the muscle; and hence the operation may be localised with reference to two chief considerations, vision and appearance. If the natural pupil is obscured by lymph, the artificial one made by the iridectomy should, if possible, be placed where it will be most useful for visual purposes—that is to say, downwards and inwards, inwards, or directly downwards. By choice, in these circumstances, the part excised should not include an adhesion; because this, when detached, is liable to leave a patch of hardened lymph and uveal pigment upon the surface of the capsule, and these residua would themselves interfere with sight. When the natural pupil is clear, and the vision nearly normal, the iridectomy should be made directly upwards, where it will be at least partly and sometimes entirely concealed by the upper lid; and it is then a matter of indifference whether the part to be removed is adherent or free.

The writer's experience of iridectomy, performed after a second attack of iritis and as a means of preventing further recurrence, is now large, and it is altogether favourable. The operation is scarcely ever followed by any kind of ill-consequence, and it scarcely ever fails of its object. When both eyes have been affected, the writer has in several instances operated first upon the worse of the two, with the result that it shortly afterwards became the better of the two, and that its increased usefulness and comfort occasioned a request that the other might be similarly treated. In many persons, the existence of an adhesion, while the iris is entire, is attended by painful sensations of dragging, and by congestion of the eyes after even moderate use, long before recurrent inflammation is excited. All symptoms of this kind are relieved by the iridectomy.

After several attacks of iritis, in some of which the choroid and vitreous have probably to some extent participated, and when the greater part of the pupil is adherent, the operations of Streatfeild and of Passavant are impracticable, and the performance of iridectomy is the only resource remaining to the surgeon. In these circumstances, the amount of benefit to be obtained must depend upon the actual condition of the organ, and the operation is no longer entirely free from risk.

Even a first attack of iritis does not invariably follow the favourable or partially favourable course which has been described. In certain states of bodily health, in cases in which the malady has been neglected at the outset, and still more frequently if the eye has been maltreated by nitrate of silver drops, or in any other manner, the inflammation may extend to the ciliary body and choroid, and may place the sight in great peril. In iritis which implicates the choroid the pupil is often obstinate in its resistance to atropia, and, in cases in which the cornea and aqueous humour retain sufficient transparency, dilated blood-vessels may often be seen upon the surface of the iris itself. The ciliary region is usually somewhat tender to the touch, the hyperæmia more pronounced, both in the conjunctiva and in the sclera, than in the simple iritis; and the impairment of sight is usually much greater than can be explained by the lymph-deposits in the pupil, or by the turbidity of the media in front of it. The ultimate tendency is to destruction of sight by wasting of the eyeball, and by complete separation of the retina from the choroid by effusion of lymph or serum. The effusions which proceed from the choroid not infrequently undergo calcareous degeneration, and in course of time they are occasionally converted into true bone, furnished with Haversian canals.

When extension of iritis to the ciliary body and choroid occurs in a case which has been under observation and skilful management from the outset, the prognosis is in the highest degree unfavourable, and the surgeon has to witness the effects of a process against which he is almost powerless to contend. It is only in irido-choroiditis which has not been treated, or which has been maltreated, that there is any hope, although even then not a large one, of arresting the morbid process, and of preserving a useful amount of vision. Our resources for this purpose are much the same as in the more severe forms of iritis, and their employment should be governed by the same principles. Unless there be some special contra-indication, the constitutional effect of mercury should be obtained as rapidly as possible. Pain should be subdued by anodynes. The strength should be supported by well-chosen diet; strict repose and protection from all irritants should be enforced; and any constitutional conditions which may be contributory to the disease should receive their due share of attention.

In such cases the pupil is usually completely closed, and, even if there be any portion of its margin which is not adherent, the muscular tissue of the iris is too profoundly modified by the inflammation to respond to atropia. In such circumstances, no good is to be expected from its employment, and it will sometimes act as a local irritant. The surgeon should bear in mind the general principle that the use of atropia, in iritis, is to dilate the pupil; and that, if the pupil cannot be dilated, the drug is superfluous, and may be hurtful. Iridectomy has often been performed in such conditions, but seldom, if ever, with benefit. The operation is attended by very free bleeding from the cut iris, and the anterior chamber becomes filled with a coagulum, which conceals the iris and pupil, often occasions great irritation, and is only very slowly absorbed. However large the piece of iris removed, the resulting gap will gradually be dragged together by lymph, and the occlusion of the pupil restored. A better resource is repeated paracentesis. If the anterior chamber be tapped, and its contents evacuated, in the manner already described, and if the puncture be re-opened with a probe sufficiently often to prevent it from healing, there will be no effusion of blood to do mischief, but a constant drain of fluid which must be supplied from the dilated veins of the eye, and which must in some degree diminish their congestion. The little wound is too insignificant to be hurtful, and the advancement of the lens and iris, consequent upon the frequent withdrawal of the aqueous humour, may prevent injurious pressure from being exercised upon the retina. If improvement be obtained, it is manifest that an iridectomy will eventually become necessary for the restoration of sight; and it should be performed during the first distinct remission of the inflammatory symptoms, before the lymph, which has been effused in the stroma of the iris, has had time to become a source of fresh mischief by the traction consequent upon its shrinkage. After the iridectomy, the treatment must be continued on the same general principles as before; and it will frequently be some months before the effused matters are fully absorbed, the media transparent, and such an amount of sight restored as the injury done by the inflammation may permit. It is not uncommon for the lens to be rendered opaque, or for its surface to be entirely covered by a semi-opaque film, and in either case it may eventually require removal. See *Secondary Cataract* under CATARACT. During the subsidence of the disease, and the period of the absorption and removal of morbid products, the most important questions to be considered will usually have reference to the continuance or disuse of mercury, and these can only be determined by watching its action in each individual case, or, sometimes, by tentatively withholding it for short periods of time.

It is manifest that inflammation of the iris and choroid cannot exist without inflammation of the intervening ciliary body, or 'cyclitis,' as this affection has been somewhat clumsily called. But in some cases the cyclitis is a subordinate, while in others it is a prominent symptom; and, in the latter class, there is great danger of the occurrence of 'sympathetic ophthalmitis,' that is to say, of the excitation of an insidious and almost invariably destructive form of irido-choroiditis in the previously unaffected eye. Such an event is most frequent when the original inflammation was traumatic in its origin, and especially when the ciliary body has itself been injured, and is, therefore, primarily affected, the iritis and choroiditis being secondary phenomena. For further information on these points, *see* EYEBALL, Injuries of the; CILIARY BODY, Diseases of the; SYMPATHETIC OPHTHALMITIS.

Serous Iritis is met with under two principal forms, in one of which the cornea participates, while in the other it escapes. In the former, the disease usually commences in an insidious manner, with little increase of vascularity, and the patient first complains of dimness of sight. The surgeon may then find one or two points of adhesion, a slight dulness and discoloration of the iris, and a fine cloud on the lower part of the cornea; which cloud, when carefully examined, is seen to be composed of an aggregation of minute dots on the inner surface of the membrane. The cloud is usually triangular in outline, its apex being in the pupillary region and its base at the inferior periphery of the cornea. There will, perhaps, be a slight zone of pericorneal vascularity, a slight increase of tension, and the second eye will, usually, be attacked in a similar manner. The disease was described by old writers as 'aquo-capsulitis,' and is apt to pursue a very chronic course. It is prone to occur in syphilitic subjects, but the writer has seen many instances in patients in whom no syphilis was discoverable. Complete functional rest of the eyes, protection from strong light and from changes of temperature, the use of atropia for the adhesions, attention to the general health, and the careful administration of iodide of potassium or of perchloride of mercury, with or without iron, and over a considerable period of time, will usually conduct such cases to a favourable termination. Such an administration of mercury as has been recommended for acute plastic iritis will seldom or never be required. If adhesions are left, when recovery is otherwise complete, they must be treated upon the general principles already laid down.

The other form of serous iritis, in which the cornea does not participate, is of a more acute character, and may be described as an attempt at acute iritis in a person incapable of yielding plastic lymph. The patients are often the subjects of some dyscrasia, often of renal disease. The effusion is more abundant than that of plastic iritis, and remains fluid, not producing adhesions, but distending the anterior chamber, pushing back the plane of the iris, indirectly increasing the tension of the whole eyeball, and thus producing great obscuration of vision. Functional rest, the relief of pain, and repeated paracentesis, constitute the chief treatment which will be required. If the tension is very high, and if the surgeon cannot see the patient frequently, so as to evacuate the contents of the anterior chamber twice a day, it will often be best to perform iridectomy. This procedure is usually followed by uninterrupted recovery; but the writer has operated on one case in which the distension had been so great, before the iridectomy was performed, that it left behind five dioptres of myopia in an eye which had previously been emmetropic.

R. BRUDENELL CARTER.

IRRIGATION, or the plan of allowing gentle and continuous currents of liquids to flow over parts of the body, is an old therapeutic resource, possessing unquestionable antiphlogistic power. Irrigation may be practised with water of variable temperature, pure or medicated; but plain cold water is most frequently employed. As the fall of temperature from evaporation is considerable, it is rarely necessary or safe to irrigate with iced water. Dry cold (*see* COLD) is, on the whole, more useful and manageable than wet; but irrigation does possess special advantages. This is more particularly the case in treating diseases of, and in cleansing, cavities such as the nose, the pleura in empyema, the bladder, vagina, and rectum. In these cases, the best and simplest plan is to irrigate on the syphon principle, through an elastic tube deriving its supply from a vessel on a higher level than the body. In treating wounds, especially foul ones, irrigation has the advantage, over stagnant wet, of promoting drainage by carrying off secretions as rapidly as they are formed; and it is readily intelligible that any antiseptic may be added to the liquid, if it be thought desirable to do so. The discomfort from wetting the body and bed-clothing is an objection to irrigation, and, to make it tolerable, every care must be taken to direct the outflow by adjusting the position of the body, and in making the bed, placing the pillows, and covering with waterproof cloth. The combination of position and irrigation greatly enhances the antiphlogistic power of the latter, as by elevation alone of an inflamed limb its supply of blood may be greatly reduced, and with it the temperature, all the more so if the raised limb be continuously irrigated.

Water may be allowed to flow from a tap or to drop on to a joint from a wide-necked bottle suspended over it, with some skeins of cotton hanging out of the bottle; or the liquid may be suspended in a small can or bucket, and left to trickle through an elastic tube, regulated by a stop-cock or a cleft stick at its lower end. Dr. James Macartney, in his *Treatise on Inflammation*, gives the following directions: 'Having laid some lint on the inflamed part, let the water be conducted by means of a strip of woollen cloth from a vessel holding the water or other fluid, which may be placed on a chair or table standing beside the bed. One end of the strip is to be inserted into the vessel; the other, which should be cut into a pointed shape, laid on the lint. The water will then proceed in the manner of a syphon continuously from the vessel, not by drops falling from a height, the sensation of which is disagreeable.' The important question as to how long irrigation should be continued, must be determined by the circumstances of particular cases. As a rule, it requires to be kept up for many hours, often for several days, before its beneficial effects are fully realised. The details of the method employed for irrigation are matters of secondary importance, affording great scope for ingenuity. The physical principles in operation are essentially those of the syphon and evaporation, and the patient's comfort is the best measure of the good done.

SAMPSON GAMGEE.

ISSUES are ulcers artificially produced and prevented from healing by the irritation of a foreign body; they may be employed as counter-irritants, and have been used to produce a continuous drain from the system.

Issues may be established by—1, caustics; 2, the moxa; or, 3, the knife; and in making them, bony prominences and the situation of nerves and vessels should be avoided.

1. To make an issue with caustic, the skin around should be protected by a piece of plaster, with a hole half the size of the required issue in the middle of it; a bit of caustic potash or Vienna paste, about the size of a pea, should be placed in the hole, and retained there by another piece of strapping for about three hours or fifteen minutes, according as the potash or the Vienna paste is used.

2. To make an issue by means of the moxa, a holder, known as the porte-moxa, having a wire-gauze receptacle at one end, is useful; some cotton-wool, tightly pressed and impregnated with nitrate of potash, should be placed in the gauze cage and ignited, and then held in contact with the skin until it is burnt. After both these methods, the injured part should be fomented to soothe the pain and irritation, and hasten the separation of the slough.

3. The knife is the least painful instrument for making an issue, but it is not so satisfactory as the other methods, on account of the difficulty of keeping the issue open. To make the issue, a crucial incision should be made through the skin by transfixion and cutting outwards, and into it a glass bead, known as the 'pea,' should be placed, in order to prevent healing and set up suppuration.

If the issue be inclined to heal too quickly, it may be dressed with savine ointment, or painted with liquor epispasticus.

BILTON POLLARD.

ITCH, the popular name for Scabies. *See* SCABIES.

J

JAW, Dislocations of the Lower.—Owing to the bony walls of the glenoid cavity, dislocation of the lower jaw is only possible in one direction—viz. forwards, over the eminentia articularis. The luxation is usually *bilateral*, but sometimes *unilateral*, and occasionally *congenital.*

The *bilateral dislocation* generally occurs during the act of yawning or laughing, when the mouth is widely opened, or it may be caused by straining the jaws apart, as in an attempt to bite a large apple. Rarely, it has been caused by violence. If the finger be placed just in front of the tragus whilst the mouth is being opened, the condyle of the jaw will be felt to pass downwards and forwards on the articular eminence, and it will be readily understood how, if the movement be carried beyond its natural limit, the condyle might slip over this bony ridge into the zygomatic fossa. Dislocation occurs less frequently in youth and age than in the middle period of life, a fact which may be to some extent explained by the obtuse angle which the ramus forms with the body of the jaw, towards the extremes of life.

Bilateral dislocation is almost invariably caused by muscular action, the mechanism of which is as follows. The digastrics, mylo-hyoids, and genio-hyoids draw the body of the jaw downwards towards the hyoid bone, which is in its turn fixed by the muscles passing from its lower border; then the external pterygoids complete the dislocation by drawing the condyles, together with the inter-articular cartilages, forwards over the eminentiæ articulares. When this has happened, the contraction of the masseters and internal pterygoids tends to maintain the dislocated position. The pathological results are stretching or slight laceration of the capsular ligaments, the carrying forward of the inter-articular fibro-cartilages upon the condyles of the jaws, slight laceration of the temporal muscles, and stretching of the lateral ligaments, the external ligament being directed downwards and forwards, instead of downwards and backwards.

The *symptoms* are gaping of the mouth with projection and fixation of the jaw. The saliva dribbles over the chin, deglutition and speech are interfered with, and the articulation of labial sounds rendered impossible. Immediately in front of the ear is a hollow whence the condyle has been displaced, and anteriorly, below the malar bone, is a projection caused by the coronoid process, whilst above the zygoma is a prominence produced by tension of the temporal muscle. The displacement gives a stupid expression to the face, and the patient, unable to express himself, points helplessly to his mouth in a manner apt to excite laughter rather than pity.

The *treatment* usually adopted is to place the patient in a chair, with his head supported against the back or by an assistant, and to introduce between his teeth the thumbs protected by lint, one on either side, in order to force the jaw back into position. The thumbs rest on the molar teeth and make pressure downwards and backwards, whilst the fingers are used to raise the chin. Another plan is to seat the patient on the floor and fix the back of his head between the knees of the operator. Two corks, two pieces of firewood, or the handles of a couple of forks are then introduced between the molar teeth, one on either side, and the surgeon placing both hands beneath the chin draws it steadily up. The condyles are thus directed into place by the jaw rotating on these artificial fulcra. A third method, recommended by Nélaton, is to press with the thumbs directly upon the coronoid processes so as to force the rami of the jaw backwards. Mr. Golding-Bird succeeded in reducing a case of eighteen weeks' standing by this method, one side being reduced before the other. Mr. Pollock reduced a case of four months' duration by placing wedges between the molar teeth and drawing the chin up by a Petit's tourniquet carried over the top of the head.

Unilateral dislocation gives rise to a projection of the jaw towards the sound side, and there exists a hollow just in front of the ear on the side whence the condyle is displaced. The deformity is not so obvious as in the bilateral dislocation, but articulation, closure of the mouth, and deglutition are all interfered with. It is, as a rule, more readily reduced than the bilateral, and by similar means.

Congenital dislocations are usually associated with deficient brain-development. *See* CONGENITAL DISLOCATIONS.

Subluxation of the jaw was described by Astley Cooper as occurring from relaxed ligaments. The condyles ride too far forward on the articular eminences, and, becoming temporarily fixed, then slip back with a jerk. *See* TEMPORO-MAXILLARY ARTICULATION, Diseases of the.

In long-standing cases of unreduced dislocation the jaws become more nearly approximated, the deformity diminishes, and the lips may be brought into contact.

R. CLEMENT LUCAS.

JAW, Fracture of the Lower.—Fracture of this bone is apt to be overlooked. It is most common just in front of the mental foramen—i.e. near the canine tooth; but it may involve any part of either the horizontal or ascending ramus. Rarely it traverses the symphysis; occasionally it extends through the neck; or the coronoid process may be broken off. Fractures of this bone are often multiple or comminuted, and generally compound. Its arched formation and loose connection enable the jaw to resist considerable force. It is broken only by great violence, which is generally direct, in the form of blows or kicks; but the condyles may be broken off by falls on the chin, and the symphysis by lateral pressure, as when a wheel passes over the side of the face.

Symptoms are displacement, mobility of the fragments, crepitus, pain, free bleeding. Displacement is sometimes great, but it is often slight. Its direction depends on the line of the fracture, and therefore varies in different cases. The anterior fragment is generally drawn down by the digastric and other muscles, and lies internal to the posterior. Fracture is apparent in the altered outline of the teeth, which, however, it must be remembered, are often naturally very irregular, and in distortion of the outer surface and lower border of the bone. Mobility and crepitus are best detected by the tips of the fingers placed on the teeth, if the jaw can be opened, and the thumbs on different parts of the ramus; or the fragments may be manipulated from without. But roughness is unjustifiable, and even gentle examination causes severe suffering. There is dribbling of the saliva and fœtor of the breath. The inferior dental nerve usually escapes injury, but in some cases it has been torn through. Necrosis is not a rare consequence, especially in instances in which the injury has been overlooked, or when the fracture is compound and comminuted. Salivary fistula is rare. Troublesome suppuration is occasionally met with, which is generally associated with necrosis. Teeth that are much loosened are generally best removed. A tooth dropped into the fissure may hinder replacement. The condyles may be so forcibly driven up in falls on the chin that the base of the skull is injured.

Treatment.—As impaction is extremely rare, the adjustment of fractures of the body or symphysis is generally easy, though it may be difficult or impossible in fractures of the coronoid process or of the neck, especially if, as has sometimes occurred, there is dislocation also. Should the fragments be interlocked, an anæsthetic may be required. In a few cases of interlocked oblique fracture it has been necessary to saw off part of one of the fragments. This, however, can very seldom be called for. Retention is often easy, but it may be very difficult, especially in multiple or comminuted fracture.

I. In simple cases, the four-tailed bandage, the ends of which cross each other as they leave the symphysis, the two upper tying at the nape, the two lower over the vertex, will suffice.

II. A splint may be thus made. A piece of brown paper, six inches by four, is made four-tailed by cutting lengthways inwards from its ends to within an inch on each side of its centre. This is then shaped to the symphysis and body of the jaw, its two upper ends passing horizontally backwards and the two lower ends being brought vertically upwards across them. A gutta-percha splint is then cut out to this model, and (after the face has been shaved and well oiled to prevent sticking) when softened in hot water is moulded over the jaw, its ends being turned as those of the paper pattern were. It should be lined with lint, and kept in position by a four-tailed bandage.

III. As the splint just described is apt to press the anterior fragment backwards, Hamilton's splint is preferable. It consists of (*a*) a firm moulded cap (of leather or gutta-percha) for the symphysis and body of the jaw, the ends of which, prolonged with webbing, pass straight upwards in front of the ear and buckle at the vertex; (*b*) of a band encircling the head on the level of the forehead and occiput, and furnished with loops at the temple through which the ends of *a* are passed; (*c*) of a band passing longitudinally over the head, and connected with *b* at the forehead and occiput, and to which *a* is also fastened at the vertex. Thus *b* and *c* keep *a* in place.

IV. The fragments may be fastened together by a ligature passed round adjacent teeth to secure fixation; or an interdental splint may be made as follows:—A thick piece of cork is mortised on its upper and lower surfaces, so that the upper and lower teeth fit into it tenon-like, and so that it deeply overlaps the lower teeth laterally. A similar but better mould is made of gutta-percha, softened so that it accurately shapes itself to the teeth. With this splint Hamilton's bandage should be used.

V. Hammond's wire splint may be used. This excellent appliance is thus made:—A mould of the teeth is taken in soft wax, from which a plaster cast is made. To this cast is fitted a piece of stout wire, skirting the outer surface of the teeth, doubling round the wisdoms, and continued so as to skirt the inner aspect also. Its ends are now soldered together. When accurately fitted to the cast, this frame is slipped over the patient's teeth, and its inner and outer portions are fastened together by wires passing between the teeth at convenient intervals. This splint allows the patient to open and close his mouth and clean his teeth—a privilege that none should despise. Sometimes the fragments, otherwise not to be kept in place, can be drilled and wired together—a troublesome operation. Union seldom fails, but it is often tedious, especially if the fragments are not securely fixed. If it is delayed, examination for sequestra should be carefully made. If suppuration occurs, the mouth must be frequently rinsed with Condy's fluid, or borax and chlorate of potash lotion. Howard Marsh.

JAWS, Closure of the.—Inability to separate the jaws may be temporary or permanent. In the former case, setting aside cases of *trismus* from nervous affections, the cause is contraction of the muscles of mastication, especially the masseter, due to irritation from an uncut wisdom-tooth. Owing to want of room between the second molar and the ramus of the jaw, or owing to some malposition of the tooth itself, the wisdom-tooth is unable to assume its normal position, and by the pressure which it exerts on the neighbouring structures, sets up irritation, which induces a state of tonic spasm of the masseter and internal pterygoid muscles.

The majority of these cases occur, as might be anticipated, about the age of twenty; and the diagnosis is easy, unless very great swelling, and possibly abscess, should have supervened and obscured the nature of the case. The treatment consists in administering chloroform thoroughly, so as to relieve the spasm somewhat and allow of the introduction of a screw-gag between the teeth, in order to separate the jaws. This must be done slowly and steadily, so as not to inflict injury upon the front teeth, and the back of the jaw may then be reached. If the wisdom-tooth is presenting in its normal position, a free division of the gum over it, and removal of the flaps thus made with scissors, will be sufficient treatment, if the patient can quietly bear a little inconvenience for a time. But when there is obviously not space for the wisdom-tooth to be erupted, room must be made by extracting the second molar, unless the wisdom-tooth itself can be reached and extracted, which is seldom the case. Occasionally the extraction of the upper wisdom-tooth, against which the lower wisdom-tooth is pressing injuriously, may completely relieve the trouble.

In whatever way room is given, relief is sure to follow, and in the course of a few hours the spasm of the muscles passes off.

Permanent Closure of the Jaws may depend upon destruction of the temporo-maxillary articulation, or more frequently upon the contraction of cicatrices in the cheek, following ulceration or sloughing. This latter condition is frequently the result of gangrenous stomatitis occurring in childhood, in which case destruction of the whole thickness of the cheek not infrequently takes place; but the same result may follow an attack of fever, &c., at any age. When the mischief is confined to the lining membrane of the cheek, the soft parts become firmly adherent to the alveoli of both jaws, and a rigid cicatrix of fibrous tissue, in which bone not infrequently develops, binds the jaws firmly together.

Under these circumstances, the patient is often nearly starved, for he can only rub soft food between the teeth, or push it with the finger behind the teeth on the unaffected side. In the cases where destruction of the cheek has taken place, although the deformity is more unsightly the patient is generally able to feed better, particularly if one of the molar teeth is wanting.

The treatment of cicatrices by simple division within the mouth is perfectly futile, for although wedges may be employed for a time to keep the jaws apart, they will certainly be drawn together by the rigid contraction of healing. In order to secure improvement in the patient's condition, it is necessary to prevent the adhesion of the cheek to the alveoli, and to restore, as far as possible, the pouch of mucous membrane between them. This can only be done by adapting to the teeth metal plates, or shields, which can be constantly worn after free division of the cicatrices, and which, reaching well beyond the gums, can prevent adhesion taking place between the cheek and the alveoli. After a long time, a formation of mucous membrane takes place in the sulcus thus formed, and the plates may then be dispensed with in the daytime, but must be worn for many months at night. It is obvious that treatment of such a protracted nature cannot be carried out in children, and that the co-operation of an able mechanical dentist is essential for success.

The method is applicable only to cases where the whole thickness of the cheek is not involved; but the extent of the adhesions is comparatively unimportant, since the plates can be adapted to both sides of the mouth.

In the case of unilateral adhesions, division of the lower jaw in front of the cicatrices, and the formation of a false joint, give very good results. Esmarch removed a wedge-shaped piece of bone, so as to secure fibrous union with free mobility, while Rizzoli contented himself with dividing the jaw from the mouth, and trusted to the subsequent movements to establish a false joint.

Esmarch's operation is a very simple one—an incision along the lower border of the jaw easily admitting of the use of a narrow saw for the removal of a wedge of bone, the base of which should be below. The only point of importance is that the section should be made thoroughly in front of the cicatrix in the cheek; for, if this is not attended to, the operation will fail. The operation is applicable to cases in which one side of the mouth is affected, and restores to the patient a very useful, though one-sided amount of masticatory power in two or three weeks, with very little suffering or annoyance.

One side of the jaw remains of course permanently useless, and there is necessarily some deformity left, but the relief is permanent.

A patient, upon whom the writer operated in 1864, called in 1880 to show how satisfactory the movement of her jaw was. *See* Temporo-Maxillary Articulation.

Christopher Heath.

JAWS, Diseases of the.—Periostitis, both acute and chronic, affects the jaws; but the former is so prone to run into suppuration with consequent necrosis, that it is only in the early stages that it can be recognised. The more chronic form is commonly connected with syphilis, and leads to the formation of nodes about the palate, and enlargement of portions of the lower jaw. In these latter cases the administration of the iodides, in full doses, gives most satisfactory results. Many cases of persistent facial neuralgia, which are unrelieved by quinine, &c., yield to the administration of iodide of potassium, and may be concluded to depend upon chronic periostitis or ostitis, with, probably, pressure upon the dental nerves.

Necrosis affects the lower, much more frequently than the upper jaw, probably in consequence of its being less abundantly supplied with blood. Beginning as periostitis, from tooth-irritation, injury, or the action of some specific poison, the general symptoms are pain, with pyrexia; and the part affected will be found to be swollen, injected, and hot, the teeth being raised from their sockets and unable to bear the slightest pressure. If relieved by timely depletion by leeches, or, better, a free incision, and the assiduous use of hot gargles and poultices, the symptoms may subside without further mischief; but usually matter has already formed beneath the periosteum before the patient is seen, and then, although promptly evacuated, necrosis is very apt to follow. Fortunately, necrosis sometimes affects the outer plate of the alveolus only, so that the teeth are supported by the inner plate, and can be kept *in situ*; but when the entire socket is involved, the teeth are rendered loose and useless, and are better away, since they only plug the openings through which the discharge should find its way out. It is very undesirable to attempt the removal of sequestra until they are completely loosened, since, by doing so, damage may be inflicted on the surrounding parts, and the process of repair be interfered with; and this is especially the case in children in whom the second teeth are still undeveloped.

It is impossible to lay down any rules for the period of separation, which must depend upon the extent and position of the sequestrum, and the strength of the patient; but ordinarily from six weeks to three months must elapse before large sequestra can be safely extracted.

By *exanthematous necrosis* (Salter) is meant the necrosis occurring in young children, for the most part, after attacks of the specific fevers, especially scarlet fever and small-pox. Necrosis of portions of the alveolus of either jaw, and usually on both sides symmetrically, or even of the whole thickness of the lower jaw, is fully recognised now as one of the sequelæ of these disorders; and doubtless many of the cases which were attributed to the administration of calomel in former days, were really due solely to the action of the specific poison. The course and treatment of these cases differ in no respect from those of ordinary necrosis.

The action of the fumes of *phosphorus* in producing necrosis of the jaws in persons employed in lucifer-match making, has now been recognised for upwards of forty years. It was found that so long as workers with phosphorus had perfectly sound teeth, their health remained unaffected; but so soon as the teeth became carious, or were from any cause extracted, the fumes of phosphorus found their way to the periosteum of the jaws, exciting periostitis with rapid necrosis.

The symptoms were severe, the swelling of the jaws and tissues of the face being extreme, and the discharge of purulent fluid from the mouth being constant and in large quantities. The general health became secondarily affected, the patient being worn out with pain and inability to take solid food, and in very severe cases being liable to gangrene of the gums and cheeks. All these discomforts have been put an end to by insisting upon cleanliness in the use of the phosphorus, by the careful examination of the mouths of the workers, but more especially by the employment of the amorphous phosphorus in the manufacture of lucifer matches.

The remarkable point about phosphorus-necrosis is the peculiar deposit of pumice-like bone, which takes place upon the sequestra. This is doubtless derived from the periosteum, although so closely adherent to the sequestrum as to be invariably brought away with it; and though resembling true bone in some particulars, it is decidedly of a lower development. A form of bone, closely resembling this pumice-like deposit, has, however, been noticed in cases in which no phosphorus was involved, and it would appear that, in some instances, possibly of rheumatic origin, the deposit of new bone partakes of this character.

Besides phosphorus-necrosis, *mercurial* necrosis was once common, not only as a consequence of the excessive administration of mercury for antisyphilitic purposes, but as a result of the destructive ptyalism produced by the fumes of liquid mercury as formerly employed in the manufacture of looking-glasses. When glass plates were converted into mirrors by sliding and compressing them on to sheets of tin-foil covered with pure quicksilver, the men employed were liable to have their teeth drop out, and frequently lost portions of the jaws, their lives being notoriously shortened. Since the introduction of a chemical process by which the mercury is deposited on the glass, these cases of induced necrosis have become almost unknown.

In ordinary cases of necrosis of the *upper* jaw, no reproduction of bone takes place, the gap left in adults being permanent, though in children the subjects of exanthematous necrosis, the granulation-tissue is slowly converted into fibrous tissue, which does not as a rule ossify. In the *lower* jaw, abundant new bone is produced by the periosteum, and, for a time at least, most extensive losses are repaired. It is certain, however, that, in course of years, a great, if not complete, re-absorption of new bone thus formed takes place, the patient being left ultimately with very little, if any, support for artificial teeth. Salter has suggested that the early application of artificial teeth would tend, by use, to strengthen and maintain the permanence of the new bone; but there are no facts to support this view.

Under the name HYPEROSTOSIS may be conveniently grouped together a number of cases in which general enlargement of the maxillary bones occurs, without any tumour which could be properly placed among the osteomata. Enlargement of the angles of the lower jaw, quite unconnected with the development of the teeth, and giving a peculiarly broad appearance to the face, occurs in otherwise healthy subjects of about twenty, and they appear to remain stationary. In true hyperostosis, however, there are large bosses of bone, often symmetrical, thrown out by the bones of the face and cranium, which slowly but steadily increase in size, producing hideous deformity, and ultimately causing the death of the patient. Cases in which the disease is unilateral may fairly be submitted to operative procedure, and the writer has twice relieved patients from considerable deformity by sawing or gouging away a portion of the projecting bone, without any external incision. In one case, that of a lady aged 39, the enlargement of the right upper jaw was attributed to a blow on the cheek; in the other, a man aged 46, the enlargement in the same situation came on apparently without cause. *See* OSTITIS DEFORMANS.

Cysts occur both in the upper jaw (*see* Antrum, Diseases of the) and in the lower, where they may be single or multiple. The origin of these cysts is probably in the cancelli of the bone, and is in many cases due to the irritation caused by neighbouring teeth; a cancellus being filled with fluid expands, and produces gradual absorption and obliteration of neighbouring cancelli, until a cyst of considerable size is produced.

The multilocular cysts of the lower jaw appear to be more closely connected with the teeth than the single cysts, since, in many cases, the extraction of teeth or stumps gives exit to a quantity of glairy discharge. Distension and absorption of the alveoli go on as the cysts increase in size, so that the walls at length become membranous, and the macerated bone shows great gaps in its outline. One remarkable clinical feature in these cases is the length of time over which they extend, without materially affecting the health of the patient, except by their size and the consequent inconvenience produced.

The *treatment* of multilocular cysts in the lower jaw depends somewhat upon the extent of the disease and the amount of solid growth connected with them. Removal of any portion of the whole thickness of the jaw should be avoided as far as possible, though this may be advisable in extreme cases. Mason Warren and Butcher have shown that by evacuating the contents of the cysts from within the mouth, and crushing in the thin walls with the fingers, a great amount of consolidation can be brought about, and if the thick lower border of the jaw be unaffected, as it usually is, a very firm basis of support for artificial teeth may thus be obtained. The operation may require repetition, and will give satisfactory results when there is little, if any, solid material connected with the cysts. When there is a solid growth in connection with the cysts, it may, if small, be removed with the gouge, but if it should be reproduced, the portion of jaw involved should be excised, since experience has shown that these growths in connection with cysts are epitheliomatous, and apt to become generalised throughout the body.

Tumours.—Non-Malignant.

I. Fibroma of the jaws closely resembles fibroma in other parts of the body, and especially the uterus. It is dense in structure, and frequently lobulated, and on section shows interlacing bundles of fibres. Two varieties of origin are found, the periosteal, springing generally from the alveolus, and indistinguishable except by its size from epulis, and the endosteal, which springs from the interior of the bone, and in the upper jaw generally makes its way into the antrum and nasal cavities, or in the lower jaw expands the inner and outer plates of compact bone. Fibroma produces absorption by pressure, and may thus destroy a great part of the skull; it stretches the skin of the face, and may by tension produce ulceration, and thus cause an aperture, but it never involves the skin, which is always loose and movable over the tumour.

Fibroma appears to owe its origin, in many cases, to the irritation of decayed teeth, which may sometimes be found embedded in the tumour or displaced by it. No treatment less radical than the removal of the portion of bone, from the periosteum of which the tumour springs, can be of avail in the periosteal variety of fibroma; but in the form in which the bone, and particularly the lower jaw, is expanded by a slow-growing tumour within it, less heroic measures may be successful. The writer has removed a fibroma by enucleation from within the antrum with complete success, and numerous museum specimens serve to show that the lower jaw is often expanded by fibrous tumours, which are amenable to the same treatment.

II. Enchondroma is of less frequent occurrence in the jaws than fibroma, and like it may be divided into periosteal and endosteal. The disease appears ordinarily early in life, springing from the surface of either jaw, or from within the antrum or the interior of the lower jaw, and grows steadily, and more rapidly than the fibroma.

It is more tuberous than the fibroma and harder than it, and, in the case of the upper jaw, is apt to send processes into the fissures and cavities of the skull, thus giving rise to great deformity by involving the nose and orbit. Many remarkable specimens of this kind are to be found in museums, the patient in some cases being suffocated by the growth involving the mouth and pharynx. And yet in these cases it will be seen that the tumour does not invade the surrounding parts except by its pressure, and could have been enucleated.

Enchondroma has undoubtedly a greater tendency to recur locally than has fibroma, and it is essential, therefore, in its treatment that free removal should be undertaken. Enchondroma of the jaws may have fibrous tissue mixed with it, or may in great part be converted into bone, and no doubt many of the remarkable osseous tumours of the jaws to be found in museums were originally cartilaginous in their nature.

III. Osteoma is found in the jaws as a cancellous or as an ivory tumour.

The simplest form is the condensed hypertrophy due to the presence of a misplaced tooth; and the fact that numerous serious operations have been performed in these cases, should make the surgeon especially careful as to his diagnosis. The cancellous osteoma has a covering of compact bone of varying thickness, but sometimes so thin as to crackle under the finger. It grows slowly to a very large size, but when removed by section of the healthy bone beyond, shows no tendency to reproduction. The ivory osteoma is met with both as an outgrowth from the lower jaw and as a tumour of the upper jaw, of which the ivory is but a portion, the rest being composed of dense cancellous bone. *See* Exostosis.

In the *treatment* of these tumours, an exploratory puncture or trephining may enable the tooth, which is the cause of the malady, to be extracted, and hence this should never be neglected, except in the case of the ivory growth. This again may be sawn off, and shows no tendency to recur, or may be extracted from the cavity of the antrum, or from the interior of the lower jaw. As a last resource the upper jaw, or a portion of the lower, may be removed with the tumour, but extensive mutilations should not be undertaken for benign and slowly increasing tumours, if they can be avoided.

Under the old term 'Cystic-Sarcoma,' was included more than one variety of solid growth in which cysts were developed. The presence of cysts was held to mark the non-malignant character of the disease, and the clinical histories of recorded cases appeared to support this view. The naked-eye appearance of the solid growths was that of a fibrous or fibro-cellular tumour, and this was considered to be its nature until the last few years.

In his 'Erasmus Wilson Lectures' for 1882, Mr. Eve fully discussed the question of these tumours being really a variety of opithelioma; and certainly the fact of a solid tumour forming after thirty years' existence of cystic disease, as occurred in a patient of the writer's, would tend to show that the disease in question is not so harmless in its course as has hitherto been supposed. Still the clinical history of these cases, and also of the cases of ordinary 'cystic-sarcoma,' differs so completely from that of ordinary epithelioma as to rapidity of progress and recurrence after removal, that further observation is necessary before a decided opinion can be arrived at on the whole question.

Sarcomata.—In connection with the jaws, various forms of sarcoma are found, many of which have hitherto been known by other names, and many recurrent growths, formerly called cancers, come properly into this class.

1. Spindle-celled Sarcoma is of frequent occurrence about the jaws, forming many of the specimens formerly indiscriminately named 'osteo-sarcoma.' The principal clinical features of spindle-celled tumours of the jaw, are rapidity of growth with invasion of surrounding parts, but no glandular infiltration, at least in the earlier stages. Free removal is essential because of the tendency to creep along the periosteum beyond the defined tumour, which is common in these cases, and recurrence is frequent. A remarkable feature in the recurrent growths is the tendency to become softer with each recurrence, and the patient dies worn out, with, rarely, secondary deposits in internal organs.

2. Round-celled Sarcoma (encephaloid sarcoma of Cornil and Ranvier and others), is a more vascular and softer growth, and hence has more of the character of a malignant tumour. It grows very rapidly, invading the skin and forming fungous protrusions, and leads to deposits in internal organs. Many of the recorded cases of 'medullary' cancer of the jaw belong to this class.

3. Myeloid Sarcoma has long been recognised in relation with the jaws, in which situation it was originally described by Paget. It is found in connection with the alveolus, forming the so-called myeloid epulis, and also in the interior of the lower jaw. Occurring in children or young adults, the myeloid growth springs from the interior of the alveolus, and protrudes between the teeth, which may be displaced. The growth is softer than the fibrous epulis and more vascular, and occasionally presents characteristic dark spots beneath the mucous membrane; or, when developed deeply in the interior of the lower jaw, it expands the bone without forming an external protrusion. The development of cysts is not infrequent in the interior of the growth, which may pulsate. A section of the tumour shows the maroon colour resulting from hæmorrhages within the tissue, so common in myeloid growths. The question of recurrence, in connection with myeloid growths, is a very important one, and it may be considered that after complete removal recurrence does not take place.

4. Alveolar Sarcoma occasionally affects the jaws, and in the Museum of the Royal College of Surgeons of England will be found a specimen of the kind. This form of sarcoma was called by Wedl 'a fibrous form of cancer arising from bone,' and should undoubtedly include the cases hitherto described as examples of scirrhus of bone.

5. Fibro-sarcoma closely resembles fibroma in external appearance, and generally grows beneath the periosteum.

6. Chondro-sarcoma, in which spindle- or round-celled sarcoma is mixed with the cartilage forming the bulk of the tumour, occurs in both jaws, and frequently leads to secondary deposits in the lungs.

7. Ossifying Sarcoma, and Osteoid Chondro-sarcoma, imply the occurrence of ossification in tumours containing sarcomatous elements, and include the cases hitherto described as 'osteoid cancer.'

Carcinoma.—The only form of carcinoma affecting the jaws is epithelioma, which is found in at least two varieties, the squamous and the tubular. The position of these depends upon the nature of the normal epithelium of the part; thus, the squamous epithelioma is developed primarily in the mucous membrane of the palate and gums, the normal epithelium of which is squamous; whilst the tubular form with cylindrical epithelium begins in the antrum or nose, the epithelium of which is columnar. *See* Antrum, Diseases of the.

Both forms of epithelioma have a great tendency to invade surrounding parts, especially the bones, and hence the difficulty of completely extirpating the disease, except by proceedings of a magnitude which may not be justifiable in the weak condition of the patient.

Squamous Epithelioma of the palate and gums begins very insidiously, and its nature is therefore often mistaken at first. Commencing as a small, ragged ulcer on the mucous membrane of the gum, it is often, and probably correctly, attributed to the irritation of decayed teeth or fangs, or to secondary syphilis, but is regarded of little importance, or is perhaps irritated by the application of nitrate of silver or other irritants.

Ulceration of the palate of an epitheliomatous character is more frequently attributed to tertiary syphilis; and even large gaps in the hard palate, caused by epithelioma, are supposed to be the result of a broken-down gumma. But epithelioma of the gum or palate probably never occurs before the age of 40, and more often nearer 60 than 50, whereas the secondary manifestations of syphilis take place as a rule earlier in life, and the tertiary symptoms are much less urgent than those of epithelioma.

By involving the subjacent bone, necrosis is induced in the course of an epithelioma, and here again error may arise if the presence of bare bone be regarded as pathognomonic of necrosis, without considering the cause.

Tubular Epithelioma has been described by Reclus under the title of *epitheliome terebrant* (boring or burrowing epithelioma). *See* Antrum, Diseases of the.

The treatment of epithelioma of the jaws, like that in other parts of the body, consists in prompt and free removal of the affected part. When the disease is confined to the gum and margin of the alveolus, comparatively mild proceedings may be justifiable in the first instance; but if the disease has gone at all deeply, removal of the upper, or of a large portion of the lower, jaw should be undertaken without hesitation. Even then it may be impossible to clear away the whole of the disease, which may extend through the lower wall of the orbit, into the spheno-maxillary fossa, and up between the temporal and masseter muscles, and beneath the temporal aponeurosis.

Christopher Heath.

JAWS, Operations on the.—In all operations upon the jaws, the greatest care should be taken to avoid extensive scarring of the face and the infliction of unnecessary deformity, particularly by breaking the line of the lower jaw. Incisions for the relief of inflammation or the evacuation of matter, and punctures for emptying cysts or the antrum, should invariably be made within the mouth. Extraction of sequestra may be performed in most cases more conveniently through the mouth than by external incision, though the surgeon may occasionally avail himself of existing sinuses. The removal of epulis, in its varieties, can be readily accomplished through the mouth, if the operator is provided with proper bone-forceps of various kinds, and even large portions of the jaws may be thus removed with success. The late Mr. Maunder on two occasions removed large portions of the right side of the lower jaw, with the surrounding tumour, without any external incision, separating the soft parts with a raspatory, and sawing the bone in front of, and behind, the tumour. The principal difficulty in these operations was not so much the separation of the tumour as its 'delivery' through the mouth, which was slightly split in one instance. Fortunately, the hæmorrhage in both cases was slight, and the patients did well; but another surgeon was less fortunate, and lost his patient by secondary hæmorrhage, but, considering the close proximity of the facial artery, and the necessary division of the inferior dental artery, this is not to be wondered at. It may be doubted whether the extra trouble and risk of the proceeding are balanced by the absence of a scar, which, in the majority of cases, need not involve the lip, and, if properly placed, will be nearly invisible afterwards.

The same may be said of the so-called 'sub-periosteal resections' of the upper and lower jaws. In cases of necrosis it is, of course, advisable to preserve all the periosteum, and in extracting a sequestrum it may be occasionally necessary to turn aside soft parts with a raspatory; but any systematic stripping of the periosteum from a jaw involved in a tumour is not only impossible in most instances, but, if undertaken, will only leave shreds of periosteum, with possibly some portions of the disease.

Removal of the Upper Jaw, whether partial or complete, may be most conveniently performed as follows, the incisions being extended as the gravity of the case may indicate:—

A straight incision through the median line of the upper lip, and prolonged on one side of the columna nasi into the nostril of the affected side, will allow the tissues of the face to be readily dissected up off the jaw, so as to expose completely the front wall of the antrum. This may then be perforated, and removed with bone-forceps, so as to permit of the extraction of a tumour from within, or room may thus be found for the removal of large portions of the palate.

In a case of more extensive disease, in addition to the incision already made, one should be begun near the inner angle of the orbit, and be carried down by the side of the nose, and around the ala into the nostril. This will allow of further reflection of the soft tissues, and more complete exposure of the bone, so that it would be easy to cut away large portions of the jaw with suitable bone-forceps, or a small saw could be readily carried horizontally from the nostril at any level desirable, so as to preserve either the palatine or orbital plate. For removal of the entire upper jaw, it will be advisable to make an additional incision below the orbit from the inner angle to the malar bone, following the natural curve of the skin-markings of the part. This incision may be prolonged on to the malar bone as far as may be necessary, and may be met at its extremity by another at right angles to it, in very extensive disease of that bone. The flap of skin is now to be reflected outwards, and this method has the great advantage of preserving the facial nerve, and of dividing only small branches of the facial artery.

Division of the bone will be required at three points—(1) the palate, (2) the nasal process of the maxilla, and (3) the malar bone, and these sections may be made with the saw or bone-forceps, or more conveniently with both. A narrow saw, with movable back, is to be passed into the nostril, and the hard palate divided with the alveolus, from which a central incisor tooth should have been previously extracted.

The saw should be kept horizontal in the nostril, and there need be no fear of damaging the pharynx with its extremity. The movable back allows the blade of the saw to pass through the bone into the mouth, thus dividing the whole of the hard palate, without the splintering which usually follows division with bone-forceps. The soft palate escapes injury from the saw, and any attempt to dissect off and preserve the soft covering of the hard palate is futile.

The nasal process of the maxilla may be conveniently notched or completely divided with a small saw, which is next to be applied to the malar bone parallel to, and immediately in front of, the masseter muscle. This cut will then run into the spheno-maxillary fissure, and the prominence of the cheek will be preserved; but in cases of very extensive involvement of the malar bone, it will be necessary to remove the whole of it by dividing the zygomatic process, and the frontal process at its junction with the frontal bone.

Before dislocating the bone, it is well to divide the soft palate transversely close to its attachment to the hard palate, which can be readily done from the mouth.

With a pair of angular bone-forceps the three cuts made with the saw should then be thoroughly cleared, and it is convenient to take them in the reverse order, viz., malar bone, nasal process, palate. The bone-forceps, when dividing the palatine attachments, may be conveniently used to tilt the whole jaw forward, and the lion-forceps should then be employed to grasp it, and forcibly depress the mass, while the scalpel is used to divide the infra-orbital nerve behind the bone, so as to prevent its being stretched, and also any soft tissues which may remain attached to the jaw.

The hæmorrhage, which is often sharp for the moment, is best checked temporarily by thrusting a sponge into the opening, and this, after a few minutes' pause, may be withdrawn in order to allow of the application of the actual cautery at a black heat, so as to sear any bleeding vessel. A careful examination should be made to see that all the disease is removed, and the flap of skin is then to be replaced and fixed with fine wire sutures and hare-lip pins for the lip, the red margins of which are best approximated by a fine silk stitch.

Unless the oozing of blood is so considerable as to necessitate plugging the wound, it is better not to introduce any lint beneath the cheek, since it only collects discharge, and becomes very offensive in a few hours, when its withdrawal is both difficult and painful. Free syringing with antiseptic lotions from the first is useful, and for this nothing answers better than the continuous stream of the syphon nasal douche. *See* Nasal Douche.

Removal of the Lower Jaw.—In removing portions of the lower jaw, the incision should, as far as possible, be placed below its border, so that the cicatrix may be hidden.

An incision from the median line to the angle, thus placed, will divide the facial artery immediately in front of the masseter muscle, and both ends should be at once secured with a ligature. The tissues of the face can then be dissected up, and the cavity of the mouth opened by dividing the mucous membrane close to the gums, when any part of the body of the jaw can be removed by making a section, with the saw, on each side of it.

In making these sections, it is better not to complete one before the other is begun, because of the loss of resistance consequent upon breaking the continuity of the bone; but each cut being carried nearly through the bone with the saw, may be conveniently finished with the bone-forceps. Should it be necessary to prolong the incision beyond the median line, and to remove the symphysis, care must be taken to guard against the falling back of the tongue by having a stout thread passed through it, upon which traction may be made. The mylo-hyoid muscle and mucous membrane inside the bone can then be divided and the piece removed, but, whenever possible, the alveolus alone should be divided, and the lower border of the jaw be preserved.

For removal of one half of the lower jaw, it will be advisable to divide the lower lip in the median line; for though it is possible to perform the operation without this, yet, if the disease is at all serious, it unnecessarily complicates the operation to save the lip, which reunites readily enough. The incision should then be carried, at right angles to that in the lip, along the lower border of the bone as far as the angle, and then upwards to near the lobule of the ear. This will necessarily divide the facial artery, but no important branches of the facial nerve, unless prolonged into the parotid gland. The tissues of the face and of the masseter being dissected up off the bone or tumour, the jaw is to be divided at a convenient point, a tooth having been previously extracted. The scalpel is then to be carried closely along the inner surface of the jaw, to divide the tissues forming the floor of the mouth, and care must be taken not to detach or damage the sub-lingual gland.

The cut end of the jaw being grasped with the lion-forceps can now be everted, so as to bring the internal pterygoid muscle into view, and this must be dissected from the bone. Should the disease be of a non-malignant character, and not involve the articulation, the ramus of the jaw should be sawn across in preference to disarticulating; and, even when the tumour encroaches very closely upon the joint, it may be possible to divide the neck of the condyle and the coronoid process separately with bone-forceps.

In order to disarticulate the condyle, the soft tissues should be held out of the way with spatulas, and the jaw being firmly grasped with the lion-forceps, is to be depressed, so as to bring the coronoid process forward and allow of division of the insertion of the temporal muscle. This is sometimes rendered difficult by an unusual length of the process, or by its being jammed against the malar bone by the bulk of the tumour. In that case, it may be necessary to cut off the coronoid process with bone-forceps, or to break it by force.

The coronoid process having been cleared, the depression of the jaw from before backwards is to be continued, in order to throw the condyle forward; but great care must be taken not to rotate the jaw outwards, or the internal maxillary artery will be stretched around the neck of the bone, and be either torn or divided, when the hæmorrhage would be severe and difficult to arrest. The condyle being made prominent, the knife is to be carefully applied over it, when the bone will start forward, tearing through and bringing away with it a portion of the external pterygoid muscle. The knife must not be used to divide the muscular fibres, which bleed less if torn, but may be employed to divide the inferior dental nerve, so as to save it from being pulled out of the bony canal. When, from the nature of the tumour, the leverage of the jaw is lost, and consequently disarticulation of the condyle becomes difficult, recourse may be had with great advantage to the broad elevator recommended by Professor Gross for disarticulating the condyle from the glenoid cavity. In this way the bone may be forced from its socket, and the risk of hæmorrhage from the internal maxillary artery be completely avoided. Any bleeding vessels should be secured with ligatures, the lip united with hare-lip pins and the wound with sutures, care being taken to leave a dependent opening for the discharges. Christopher Heath.

JOINTS, Diseases of.—In considering the subject of joint-disease, it is well to bear in mind the structure and function of the part concerned; for it will be found, in practice, that in no class of diseases are these more intimately related to symptoms and treatment. Thus, the structures which usually enter into the formation of a joint are bone, cartilage, synovial membrane and ligament; surrounding the joint are muscles, with their corresponding vascular and nervous supplies, the arterial anastomoses being in most cases very free, and the nerves supplying the joint being derived from those that are distributed to the muscles which move it.

The *symptoms*, in any individual case of joint-disease, will vary in accordance with the particular structure which in that case is chiefly affected; and the determining of the part in which the disease originated, will often aid our diagnosis of the constitutional or other condition upon which it depends. So also in regard to function. The proper function of a joint is limited movement, which should be accomplished without pain or sensible friction. In disease, this function is disturbed in a manner which is indicative of the character and seat of the morbid process.

It will be observed that nearly all *acute* inflammations of joints commence as synovitis, although, if the process is not soon arrested, the other structures—cartilage, bone, ligaments—also become involved. These acute inflammations have their origin either in injury—as, for example, a sprain or wound—or in the constitutional diseases pyæmia and rheumatism, of which the joint-affection is but a part.

The *subacute* and *chronic* joint-diseases exhibit a much greater variety both in the tissues affected and in the mode of origin. These are either secondary to the more acute forms, of which a chronic traumatic synovitis is a common example; or they are due to divers constitutional conditions, of which the most frequent are scrofula, rheumatism, syphilis, gout, and some of the milder forms of septic infection. Very often too, an injury will be found to be the starting-point of a chronic joint-affection, the persistence of which depends upon constitutional disease.

It will be convenient to describe the diseases of joints, first in relation to the particular tissue which is chiefly affected; and secondly in relation to the associated constitutional condition.

Diseases of the Synovial Membrane. Of all the joint-structures, the synovial membrane is the most liable to the various forms of inflammatory disturbance. It is exceedingly sensitive to injury, and to any changes in the amount or character of its blood-supply.

In *Acute Synovitis* the synovial membrane rapidly becomes swollen and vascular, losing its natural smoothness, and presenting a velvet-like surface; at the same time the cavity of the joint becomes distended with an abundant secretion of slightly turbid synovia. Minute blood-vessels are seen traversing the membrane and giving it a brilliant red colour, with here and there patches of deeper tint, so that its encroachment upon the cartilages is rendered very obvious. Under the microscope, the synovial fluid is seen to contain leucocytes, oil-globules, and shreds of fibrinous material; the cellular element increasing in proportion to the severity of the inflammation, and the fluid approximating in varying degrees to the character of pus.

The *symptoms* are pain, heat, and swelling of the joint, together with pyrexia. The pain is of an aching and throbbing character, greatly aggravated by movement or interarticular pressure; the joint not only feels hot to the patient, but its temperature is actually raised; the swelling corresponds to the limits of the synovial sac, it obscures the natural outlines of the bones, and fluctuation can be felt across the joint. The muscles which act upon the joint are in a state of rigidity, and fix it, usually in the position of partial flexion. The pyrexia varies in proportion to the size of the affected joint and the acuteness of the process. There are often some premonitory rigors. The result may be either the complete subsidence of the inflammation, the joint being left for a time somewhat tender and loose from the stretching its tissues have undergone; or there may be partial subsidence into the condition of chronic inflammation; or suppuration may ensue.

The occurrence of *suppuration* is indicated by marked increase in the constitutional disturbance; rigors occur and may be repeated, the temperature rises, the pulse is quickened, and if the joint affected be a large one (e.g. the knee), the patient is gravely ill. There is not necessarily any increase in the amount of fluid in the joint, but the tissues around usually become œdematous, the skin red and hot, and the pain very severe, so that appetite and sleep are lost. Painful startings of the limb now occur, and any movement of the joint-surface is attended with severe suffering. The ligaments also become softened, so that, unless means are taken to prevent it, displacement of the bones takes place in the direction in which the muscles have most power.

If exit is not now given to the pus, it makes its way out of the joint into the surrounding tissues and then to the surface. As the suppuration progresses, the cartilages become ulcerated and detached, the bone-surfaces exposed and displaced, and the joint is thus irretrievably damaged; while at the same time the patient is in danger of pyæmia, hectic, and exhaustion, from which he is often only to be rescued by amputation of the limb.

Suppuration of a joint is not, however, necessarily attended with ulceration of the cartilages, though it usually is. Early incision and free drainage may be followed by recovery, with little or no impairment of movement. In the majority of cases, however, the most favourable result that can be obtained is a joint more or less fixed by adhesions, and weakened by softening and destruction of its ligaments; limitation of the natural movements by adhesions being often accompanied by too great mobility in other directions.

The *treatment* of acute synovitis in a healthy person should be antiphlogistic and decided, for it is of great importance to arrest the morbid process at the earliest possible stage. The maintenance of the joint in a condition of rest is the first essential; this must be attained by the application of suitable splints or other apparatus for ensuring immobility. *See* Ankle, Elbow, Hip, Knee, Shoulder, Wrist.

At the outset of the inflammation, leeching is of great value; ten leeches applied to a joint such as the knee, or six to the elbow, may cut short the attack at its commencement. Great pain is a special indication for leeching, which almost always gives relief. If the abstraction of blood is undesirable, cold should be applied to the joint by means of an ice-bag, Leiter's tubes, or evaporating lotions. In the beginning of traumatic synovitis, elastic pressure made with an india-rubber bandage, over which an ice-bag can be placed, is often very useful. In some cases, however, it will be found that warm fomentations are more comfortable and equally beneficial.

Besides such local measures, a purgative will generally be needed, and, if the constitutional disturbance be severe, opium should be given in small doses frequently repeated, to which, if the pulse be hard, a little tartar emetic (gr. $\frac{1}{10}$th to gr. $\frac{1}{6}$th) may be usefully added. If the distension of the joint is not thus diminished, it should be punctured with a fine trocar or aspirating-needle, and the distending fluid be withdrawn. Every possible care must be taken to prevent the entrance through the puncture of any septic material into the joint, and gentle elastic pressure should be maintained after the evacuation of the fluid. A convenient method of procedure is to encircle the joint with an elastic bandage, between two of the folds of which a small interval is left; in this interval the joint is punctured with a fine hollow needle attached to a syringe with a glass barrel, so that the nature of the fluid can be observed. The skin around the point of puncture is to be previously washed with a solution of carbolic acid (1 in 20), and the needle thoroughly cleansed in the same solution. The needle should be introduced obliquely, and the fluid gently and slowly withdrawn, the suction of the syringe being arrested as soon as the fluid ceases to flow readily, or if it become tinged with blood. On the needle being removed, the little wound is immediately closed with plaster.

Puncture of a distended joint, thus performed with strict antiseptic precautions, is a safe method of relieving tension, and the withdrawal of even a small quantity of the fluid is often followed by immediate subsidence of the inflammation and the gradual absorption of the remaining effusion. If, after the acute stage has passed, there still remain an excess of fluid in the joint, its removal will probably be obtained by the application of a blister, or by maintaining even pressure by means of an elastic bandage or frequently renewed strapping. After an attack of acute inflammation or distension, the tissues of a joint are left loose and softened; support should therefore be given, by strapping or bandaging, for some weeks after the use of the joint is recommenced.

If the inflammatory process passes on to the stage of suppuration, the gravity of both local and general conditions is greatly increased. The time for depletion is now passed, the patient's strength will require supporting rather than depressing, and our efforts must be directed to maintaining the best local and constitutional conditions for the repair of the damaged joint. If, then, the symptoms are such as have been described above as indicating suppuration of the joint, and especially if the patient's temperature remains persistently high, the character of the contained fluid must be ascertained by antiseptic puncture with the exploring syringe. Should the fluid withdrawn prove to be only turbid, and not actually purulent, its removal may be the first step towards recovery, and the avoidance of suppuration may still be hoped for. If, however, the fluid prove to be pus, its free evacuation is urgently needful. For this purpose the joint must be freely incised in such a situation as will best ensure complete drainage: its cavity must be syringed out with an antiseptic solution (e.g. 1 part of carbolic acid to 40 parts of water), and the wound dressed with absorbent antiseptic dressings.

The success of the treatment will depend very much upon the efficient drainage of every part of the joint-cavity, and upon the avoidance of septic infection. The strictest antiseptic precautions must be observed. The incision must be made, if possible, in the most dependent position, a drainage-tube must be inserted to ensure the patency of the wound, and, if the joint does not thoroughly empty itself, it must be daily washed out by gentle irrigation with carbolised water. A good form of dressing is a pad of carbolized wool enclosed in a double layer of eucalyptus or carbolized gauze, which should be changed sufficiently frequently to prevent the discharge soaking through or decomposing. The temperature should be carefully watched, and any sudden rise taken as an indication for an examination of the joint, to make sure that the route of exit for the matter is quite free.

The incision of a large joint is doubtless a very serious proceeding, but the detention of matter within the cavity of a joint is still more dangerous; and, if the precautions indicated above are observed, the operation is often followed by an immediate improvement in the general condition of the patient, and may even lead, in young subjects, to complete recovery of the functions of the joint; in the adult, however, ankylosis is the more common result.

Should the evacuation of matter not be followed by a satisfactory improvement, the question of amputation will have to be considered. The decision must be based upon a consideration of the reparative power of the patient, the severity of the constitutional irritation, and the probable usefulness of the limb if preserved. Age, habits, diathesis, and environment must all be taken into account, and of course each case must be decided on its own merits; but in general terms it may be said that amputation is called for when, in spite of free drainage of the joint, the suppuration does not diminish, and the patient is losing ground, and becoming worn out by pain and fever. When under such circumstances the source of irritation is removed by amputation, health is often recovered with surprising rapidity.

During the period of suppuration, the environment of the patient should be carefully looked to, for the progress of the case will be greatly influenced by hygienic precautions. A well-ventilated room, nourishing and easily-digested food, scrupulous cleanliness, protection of points of pressure against the formation of bedsores, the administration of suitable tonics (of which quinine is especially to be commended) and stimulants (which often act most usefully in promoting sleep as well as supporting the strength)—these, and the care of an efficient nurse, are the aids to recovery which are to be especially desired.

Sub-acute Synovitis is a distinction which it is convenient to maintain, both from the acute form which has been described above, and from that variety which is from its commencement characterised by indolence and chronicity. Every gradation is, in practice, met with between the most acute and the most chronic form of joint-inflammation; but there is a large number of cases in which the causes at work are the same as those which give rise to the acute disease, but which, operating less actively, produce effects similar in kind but less in degree.

This is the subacute group, which in no way resembles, either in its causation or in its local and constitutional concomitants, the chronic form to be subsequently described, but which has everything in common with the acute form excepting its virulence. An example of subacute synovitis would be that caused by a sprain in a healthy person. The injury is followed by a rapid effusion into the joint of nearly clear synovia, giving rise to a corresponding amount of swelling, tension, heat, and pain. Movement of the joint is restricted and painful. There is slight constitutional disturbance, the temperature reaching, perhaps, 100°. If the part be kept at rest, the symptoms soon subside. There is but little tendency to suppuration, the health is unaffected, and in a few weeks the joint is restored to partial or complete activity.

The *treatment* of this class of cases must be regulated in accordance with the degree of activity to which the inflammatory process attains. At their commencement, severe or increasing pain may usually be taken as an indication for leeching; but the majority of the subacute inflammations of joints are to be arrested by the application of cold and pressure, and the maintenance of rest. After the subsidence of the early symptoms, there very commonly remains more or less excess of synovial fluid in the joint, and for this repeated blisters should be used, followed by elastic pressure or the application of strapping.

It is often necessary to maintain some form of pressure upon the joint for several months, in consequence of the tendency to re-accumulation of fluid within the joint which these cases exhibit. Should this passive form of effusion recur without fresh inflammatory symptoms, the application of what is usually known as a 'Scott's dressing' will be found very useful. This is a combination of pressure with mercurial inunction. The joint is to be enveloped in strips of lint, on which is spread the camphorated mercurial ointment; over this several layers of firm adhesive plaster are to be strapped, so as to make even pressure on all parts of the joint, to restrict its movement and to give support; outside all a gummed bandage is to be placed. It is to be borne in mind that an essential part of this method is the use of even pressure, so that the joint must be restrapped every few days, or as often as the plaster becomes loose. In some instances, this passive effusion is persistent in spite of such treatment, or recurs immediately that the joint is released from pressure. This condition, found chiefly in the knee, is called *hydrops articuli.* For this the removal of the fluid by aspiration, followed by the use of a Scott's bandage, should first be tried. If this fails, the joint is to be injected with a mild aseptic stimulant. A 1 per cent. solution of carbolic acid in water may be injected by a fine syringe into the previously emptied joint ; the solution, having been brought into contact with every part of the synovial cavity, is then withdrawn, and finally the joint is covered with a layer of cotton wool half an inch thick, which is bandaged over it so as to maintain moderate pressure and yet allow of some swelling. *See* HYDRARTHROSIS.

The result of the injection will probably be some slight inflammation and swelling, which on its subsidence leaves the synovial membrane in a condition less prone to excessive secretion. The joint must be kept at rest during this treatment, and, should any acute symptoms arise from the injection, they must at once be combated by the use of cold or other antiphlogistic measures. Should the mild solution recommended not suffice, a stronger must be used, or a mixture of tincture of iodine and water (1 in 10) may be substituted.

Many cases of subacute synovitis are kept up by the presence of adhesions within the affected joint. This cause may be suspected when a joint, which has previously been more acutely inflamed, is liable to frequently recurring attacks of pain and swelling, provoked by any unusual exercise or freedom of movement. On examining such a joint, pain will be evoked whenever the limb is moved in some particular direction, in which also movement will be found to be unnaturally restricted; very often a painful spot can be exactly indicated by the patient. In these cases the synovitis is kept up by the stretching of the adhesion, and may be promptly brought to an end by the forcible rupture of the adhesion, which must be done by a sudden and unexpected movement, so that the muscular resistance is evaded by surprise; or else while the patient is under the influence of an anæsthetic. *See* BONE-SETTING.

Chronic Synovitis is the most common of joint-affections, and will often be found to be associated with some morbid diathesis, such as scrofula or rheumatism. Yet there are many cases—especially in children—in which the joint-affection is the only sign of disease, and which are, without doubt, of local origin. These are mostly due either to neglect of the original injury, so that the joint is not given a fair chance of recovery—a condition often met with among the children of the poor owing to their domestic difficulties; or they arise from repeated injuries to a damaged joint—a not uncommon occurrence, because a joint once weakened by inflammation is all the more prone to subsequent accidents.

But the very persistence or chronicity of a synovitis, unless it be thus accounted for, should lead us to suspect some constitutional error, the discovery of which may be essential to the effectual treatment of the disease. Chronic inflammation of the synovial membrane may be the result of the subsidence of the acuter forms, in which the membrane, instead of recovering its normal condition, remains somewhat swollen and vascular, and secretes an excess of synovial fluid; or the process may be, from the commencement, of a slow and indolent kind. The joint is observed to be swollen, partly from fluid in its cavity, and partly from thickening of the synovial membrane; it is slightly hotter than the corresponding joint of the opposite side, and is moved a little less freely. There is tenderness, often of limited area, and confined to one or two spots. Pain is trifling, and perhaps only elicited upon extreme flexion or extension. If the affected joint be of the lower extremity, there is more or less lameness, chiefly owing to the involuntary restriction of the natural movements.

As the disease progresses, the synovial membrane becomes gradually more thickened and pulpy, the bony outlines of the joint are concealed by a general elastic swelling, giving to the touch a deceptive sense of fluctuation; the ligaments soften, the bone-surfaces become displaced, and the functions of the joint are slowly but surely lost; at the same time the related muscles undergo proportionate wasting. If the interior of such a joint is examined, it will be found that the synovial membrane presents morbid changes of much greater extent and degree than the other joint-structures. The ligaments may be softened and stretched, and the cartilages eroded here and there, but the bones remain unaltered. The delicate synovial membrane of health is replaced by a thick, semi-opaque, gelatinous mass, which is adherent to the cartilages, and bulges into all the less resistant parts of the joint.

In some few instances, the thickened membrane develops a fringe of pendulous growths, which project into the cavity of the joint; these may become elongated sufficiently to allow of their free movement within the joint, or may become entirely detached, and so give rise to the symptoms of Loose Cartilage. But more usually the growth affects uniformly the whole of the synovial membrane; it may attain the thickness of a quarter or half an inch; it is of yellowish-brown colour, intersected with white streaks and a few small blood-vessels; its consistency varies from that of friable granulation-tissue easily breaking down under the finger, to a toughness almost approaching that of fibro-cartilage. Microscopic sections of this material show it to consist of a delicate fibrillated stroma, containing in its meshes free nuclei and nucleated cells of varying size and shape, but mostly of somewhat oval outline.

This stage of the disease may last a long time—months, or even years—giving rise to but little pain, and causing but slight inconvenience beyond the weakness and diminished mobility of the affected joint; but nevertheless, when the synovial membrane has once undergone pronounced gelatiniform degeneration, the condition is one which does not admit of the restoration of the integrity of the joint. Usually, indeed, the disease is slowly progressive. In advanced cases, numerous points of fatty degeneration and of suppuration may be seen in the thickened synovial tissue, and sometimes its entire free surface is covered with a distinct layer of pus-secreting granulation-tissue.

When suppuration occurs within the substance of the pulpy membrane, matter may make its way either to the surface or into the interior of the joint. If it come to the surface, a localised swelling forms over some part of the joint; if this be not opened the skin slowly ulcerates, ill-formed flocculent pus escapes, and an indolent sinus remains. If, on the other hand, the progress of the matter is into the interior of the joint, a chronic suppuration of the joint ensues, which gradually leads to its complete disintegration. But suppuration of a joint, thus altered by previous chronic inflammation, differs entirely, both in its gravity and its symptoms, from the acute form which has been described above. There is usually some little increase of pain and swelling, and the temperature rises at night; but in many cases the symptoms are but little aggravated, and the destruction of the joint is indicated more by the increasing displacement and ligamentous softening than by any marked constitutional disturbance.

The *treatment* of the earlier stages of chronic synovitis resolves itself chiefly into securing the immobility of the joint, and the use of some form of counter-irritation. At the same time the constitutional condition of the patient should be carefully regarded, any morbid tendencies as far as possible counteracted, and the reparative powers assisted and maintained. As the joint must be kept at rest for a considerable period, it is important to arrange this without confining the patient to the house. In the upper extremity this is easy; but when the joints of the lower limb are affected, some ingenuity is necessary to allow of locomotion without harmful joint-movement. In the majority of cases, it will be found that a well-moulded leather splint is by far the most comfortable apparatus for maintaining immobility. A cast of the limb should be taken, and the leather moulded thereon. The splint should extend sufficiently far, above and below the affected joint, to keep the muscles which act upon the joint in complete rest; it should be made to lace, so that it can be easily removed and reapplied; and great care should be taken to avoid undue pressure upon all bony prominences. Plaster of Paris, paraffin, and similar kinds of splints have the great disadvantage that they do not allow of the inspection and cleansing of the skin, so easily permitted by the laced leather splint. Most of the felt and other plastic materials invented for the purpose have the defect of becoming softened by the heat of the body, and thus soon losing their efficiency. Gutta-percha is worse than useless.

In the upper limb, in addition to the splint, the arm should be carried in a sling.

In the lower limb, the affected joint being fixed by a splint, the patient may move about with the aid of crutches, the boot of the sound limb being sufficiently raised, by adding to the sole, to keep the diseased limb off the ground; or, if the tarsus be affected, the weight may be borne upon a knee-rest with a wooden leg. A Thomas's splint—i.e. a metal band moulded to the back of the limb, with cross-grips to keep it in position—is also very useful for the hip or knee.

If the synovial thickening be only slight, great benefit will be obtained by the light application over the joint of the actual cautery, repeated at intervals of about a week; or by the use of small and frequently repeated blisters, after which the joint should be strapped in camphorated mercurial ointment. Sulphur ointment, rubbed into the joint and applied beneath a flannel bandage, is also useful; and as recovery is approached, friction, the warm douche, and passive movement may be added with advantage. If, however, the synovial disease has advanced to the stage of pulpy degeneration, a cure must not be expected. The intractable nature of this form of joint-disease has long been recognised, and the accuracy of Sir Benjamin Brodie's statement that in its advanced stage it does not admit of cure, still remains undisputed. It is true that a long perseverance in treatment of the kind indicated above—i.e. rest and counter-irritation—may succeed in reducing the joint to a condition which is tolerable to a person in good circumstances. A splint being worn, and the limb but gently used, the joint may remain in a lamed but painless and quiescent condition for many years. But to those for whom an active or laborious life is a necessity, or whose means do not allow of a long period of idleness, some more radical treatment is needful. In the upper extremity, and especially when the elbow is the joint affected, excision offers a very satisfactory prospect; and indeed the condition is one to which this operation is particularly applicable. In the lower extremity we have a choice of several methods of treatment.

In children and young persons an attempt may be made to dissolve away the morbid synovial growth. For this purpose, a solution of sulphuric acid (one part of acid to two parts of water) has been freely applied to the interior of the joint by means of strips of lint soaked in the solution and introduced through free incisions. More or less ankylosis usually results, but in some instances very useful movement has remained. Iodoform has also been injected into the thickened membrane, and in some cases with decided benefit; its action appears, however, to be somewhat uncertain. Another plan is to open the joint and scrape away, with a Volkmann's spoon, as much as possible of the diseased membrane and granulation-tissue.

If there is much displacement of the bones, and the health and age of the patient are such as to warrant the expectation of sufficient reparative power, excision will be the appropriate treatment. In these cases of synovial disease it suffices to remove a very thin slice of bone, the aim being the removal of the pulpy synovial tissue, and just so much of the articular surfaces of the bones as to enable ankylosis to take place in a favourable position of the limb. When abscess has occurred, and the joint has suppurated, the same treatment will be necessary. In the upper classes to whom time and expense is of less consequence, the evacuation of matter, the cleansing of the cavity of the abscess or of the suppurating joint with antiseptic dressings, and careful support of the reparative powers, will in most cases lead at last to the desired ankylosis; so that excision or amputation are but rarely called for. But amongst the poor, who cannot afford either the time or the other aids needful to this end, it is best to rid them of their disease at once by excision or amputation. Amputation is indeed sometimes urgently necessary on account of the drain upon the health caused by the suppurating joint; and it must be remembered that excision is much the more severe operation of the two, and requires for its successful issue a much greater amount of endurance and reparative power.

DISEASES OF THE ARTICULAR CARTILAGE. It has been frequently asserted that there is no such thing as primary disease of the articular cartilage, and it is certainly true that disease of this structure is generally secondary to affections of the joint-ends of the bones or of the synovial membrane. Yet there is good reason to think that the changes associated with the disease known as 'chronic rheumatoid arthritis,' or 'osteo-arthritis,' have their origin in a low form of inflammation or degeneration of the articular cartilage. *See* OSTEO-ARTHRITIS. There are, moreover, certain cases to be met with, wherein the ulceration of the cartilage occurs at an early stage of the joint affection, and in which the symptoms depending upon this ulceration and the consequent exposure and inflammation of the articular lamella of the bone are notably predominant.

Such cases are characterised by the early occurrence of extremely painful startings of the limb, and by the slight degree of accompanying swelling and constitutional disturbance. In this form of joint-disease the limb is very soon disabled for use, because of the extreme painfulness of any movement of the joint surfaces; and a distressing feature of such cases is the disturbance of rest by the muscular spasm, which is apt to occur just at the commencement of sleep, and which brings into acutely painful contact the sensitive bone-surfaces where exposed by the removal of the cartilage. This is especially the case in disease of the hip-joint, and gives rise to the characteristic 'night scream' of children thus affected. This symptom depends, not upon the mere inflammation of the cartilage (which there is good reason to believe is not a particularly painful process), but upon the inflammation and exposure of the articular lamella of the bone; and the occurrence of this symptom, during the progress of any case of joint-disease, may be taken as highly significant of the destructive process having reached the stage of ulceration of the cartilage and exposure of the bone.

Articular cartilage, which is undergoing inflammation and ulceration, exhibits to the naked eye changes both of colour and texture. Instead of the pearly blue colour and perfect smoothness of health, there will be seen patches and lines of a yellow tint. The surface is sometimes roughened and fibrous, sometimes marked with little pits, giving it a worm-eaten appearance. In some parts the cartilage is seen to be eroded, thinned, softened, or entirely removed; it is easily separable from the bone, or may have become detached in pieces of considerable size. Microscopic examination shows the process to consist of an increase in the size and number of the nuclei of the cartilage-cells, and absorption of the hyaline intercellular material. This leads to rupture of the cell-wall and escape of the nuclei which have undergone granular degeneration, and thus to loss of substance or ulceration. In more chronic cases, the cartilage is found to have undergone fibrillation rather than ulceration: or its destruction may be due to encroachment upon its attached surface by granulations springing from the bone beneath. If the disease is arrested before any considerable destruction of the cartilage has occurred, the surface may heal by the formation of fibrous tissue, which may merely fill up the gap, or may form an adhesion to a corresponding spot upon the opposite surface of the joint. If the cartilage be extensively removed, either the joint will be destroyed by suppuration or, the destructive process coming to an end, there will be an effort at repair, and the opposed bone-surfaces will become firmly adherent by fibrous or osseous ankylosis.

In the *treatment* of this variety of joint-disease, counter-irritation, especially by the actual cautery, will be found of great efficacy. Rest, by extension or suitable splints, is also of course essential, and may be much aided by the internal administration of opium, or the subcutaneous injection of morphia. Tenotomy of muscles, the contraction of which is producing inter-articular pressure, is also sometimes useful.

DISEASE OF THE ARTICULAR END OF A BONE.—A great number of cases of joint-disease have their origin in inflammation of the adjacent bone. This may be acute or chronic.

In acute periostitis and osteo-myelitis, the inflammation may spread to the joint-end of the bone and thence to the joint, terminating often in acute suppuration. But, if the disease begin in the shaft of the bone, it is often limited by the epiphysial cartilage, and thus, though the joint may be somewhat disturbed by the contiguity of the inflammation and show signs of effusion within its cavity, it may yet escape the destructive suppuration which has attacked the adjacent bone.

Acute inflammation may, however, commence in the epiphysis, and when this occurs the joint is almost certain to become involved. This is a disease chiefly of early infancy; it has been described by Mr. Thomas Smith as 'acute arthritis of infants,' and of 22 cases related by him, 8 occurred in infants under a month old, 4 in infants under two months, 7 between the ages of two months and six months, and 3 in children between six months and one year old. The disease is an acute one, and runs a rapid course, usually to destruction of the joint and death, often by pyæmia, but sometimes to recovery, with a shortened limb and weakened joint.

The first *symptom* is usually impaired movement: the child keeps the limb fixed in a position of partial flexion, and gives evidence of pain on any attempt at movement of the joint. The pain rapidly increases, the joint becomes hot and swollen, and the child is very ill; suppuration rapidly ensues, and the abscess bursting or being opened, either death soon follows, or the discharge quickly diminishes, healing takes place, and the child is left with a more or less crippled but often very useful limb. Ankylosis rarely results in this form of joint-disease.

The suppuration occurs, in many of these cases. in the centre of the epiphysis, the matter making its way into the joint by a small sinus; or it may begin just beneath the articular lamella; or the joint-surface of the epiphysis may be first attacked, and destruction and separation of the whole or part of the epiphysis rapidly ensue. Several joints may be simultaneously or consecutively affected, but this is not incompatible with recovery. *See* EPIPHYSES, Affections of.

The *treatment* of this disease consists of early evacuation of matter, careful feeding and support of the child's reparative powers, and the maintenance of rest in the joint. This last is often best attained, in these young infants, by surrounding the limb with a soft pillow or junk, rather than by the application of the ordinary splints.

CHRONIC ARTICULAR OSTITIS is a much more common affection than the acute form described above. Although frequently met with in children, it prevails at a somewhat later age than the acute disease. The result of chronic inflammation of the cancellous tissue of the expanded joint-end of a bone is, very often, the formation of a circumscribed central slough. A limited portion of the cancellous tissue in the centre of the bone dies, suppuration occurs around it, and the result is a circumscribed abscess, in the centre of which is either a defined fragment of necrosed bone, or a small round mass of softened carious bone, separated by a perfectly-defined line from the surrounding healthy tissue, from which it can be easily turned out. Usually the matter at last makes its way into the neighbouring joint, but occasionally the inflammatory products undergo caseous degeneration and remain enclosed in the surrounding bone, as circumscribed yellow masses, which have been sometimes described as 'crude tubercle.' In other cases, however, the process leads to ulceration of the bone, either upon the surface of, or just beneath the articular lamella, and thus to the earlier implication of the joint.

The *symptoms* of chronic articular ostitis are, as a rule, very slowly and gradually developed. A dull aching, in one of the bone-ends entering into the formation of a joint, may persist for many weeks or months before any other signs are manifest. Then comes slight restriction of joint-movement, and some tenderness on pressure. Later still a little swelling may be detected, and this is chiefly a thickening of the periosteum and other structures immediately over the bone, so that the natural outlines and prominences are less easily felt and seen than on the corresponding healthy bone of the opposite limb. The swelling is but slight, and is often irregular—that is to say, more marked on one side of the bone, or there may be a circumscribed and painful swelling at one spot.

A careful examination will often detect some small area, over which deep firm pressure will always produce pain. At last there usually appear signs of implication of the joint; swelling, due to fluid effusion into the synovial cavity; starting pain and muscular spasm; peri-articular œdema and increased local heat. At the same time the temperature of the body rises, and there are other signs of constitutional disturbance, such as rigors, loss of appetite, and impaired sleep. The earlier the joint-implication the more severe are its symptoms. When the disease has been of long duration before it penetrates to the joint, its progress is usually accompanied by chronic synovial thickening, and in such cases the commencement of suppuration of the joint is not necessarily manifested by any very marked increase of the symptoms. Matter may slowly make its way along the epiphysial junction to the surface, or burrow along the tendons and intermuscular planes, and point at a considerable distance from the joint. Sinuses are thus formed, which have the prominent granulations at their orifices significant of their leading to diseased bone.

Treatment.—It has been the fashion to speak of this type of joint-disease as 'scrofulous,' and there can be no doubt that many cases occurring in children are associated with other marks of the scrofulous diathesis. But certainly the majority have no such connection, and are met with in persons otherwise quite healthy; a large number of these may be traced to a traumatic origin. No reminiscences, therefore, of the name 'scrofulous' should deter the surgeon from adopting antiphlogistic treatment at the commencement of the disease.

Deep-seated pain in a joint-end, such as is significant of commencing articular ostitis, is often immediately and permanently relieved by the application of a few leeches, or of the actual cautery; and there is no reason to doubt that the disease has often been thus arrested at its outset. The joint must be kept at rest by means of splints; and a gentle course of biniodide of mercury is certainly frequently beneficial. Later on, if pain is persistent in one spot, and especially if there be deep-seated tenderness, an attempt should be made to reach the inflamed area by incision of the bone. Even if suppuration may not have occurred, this measure will probably be followed by relief. If the painful spot is accessible without interference with the joint, it should be cut down upon and its surface carefully examined for any evidence of disease. Sometimes the opening of a minute sinus may be found leading into the suppurating cavity, or the periosteum may be raised by a little inflammatory effusion, or the bone surface may be altered in colour; any such indications as these should, of course, be followed with regard to the direction in which the bone should be perforated; should no change be discoverable on the surface, the locality of the pain must be taken as the guide.

If the reflexions of the synovial membrane have such a relation to the seat of pain, as to prevent the possibility of cutting down directly upon it without opening the joint, the inflamed part must be reached indirectly by perforating the bone at the nearest accessible spot outside the limits of the joint. If the bone is hard, it is best opened with a small trephine; if soft, a gouge or a narrow chisel may be conveniently used; for exploratory purposes a carpenter's bradawl will be found a useful instrument. If a spot of central caries or necrosis is found, the diseased or dead bone should be removed, as well as the granulation-tissue which surrounds it. If an abscess be opened, its wall should be scraped, and the cavity and any sinus leading to it should be sponged out with a solution of chloride of zinc (40 grains to the ounce). If the necrosis be of the joint-surface, it is still sometimes possible to remove the sequestrum and leave a comparatively useful joint. If the synovial membrane have undergone much thickening, and there is extensive caries of the articular lamella, excision or the treatment by sulphuric acid, described above, will probably be indicated, if the patient be still in childhood or youth. In those past this period of life amputation will generally be the safer treatment.

When the bones of the carpus or tarsus are the seat of destructive inflammation, and the disease is limited to one or two bones, excision of the affected bone or bones is often attended with excellent results. This is especially the case in the foot, wherein the disease is very often confined to the calcaneum or astragalus.

DISEASES OF THE LIGAMENTS. — The ligaments are seldom the seat of primary disease, and, from their resistant qualities and somewhat passive function, are usually amongst the last of the joint-structures to yield to the destructive influence of surrounding inflammation.

When, in consequence of an acute synovial distension, the ligaments are considerably stretched, their nutrition is so far interfered with that they undergo an amount of softening which leaves the joint weak and loose, long after the fluid has been absorbed. So also after sprains, the ligaments which have been stretched or torn are softened by the resulting inflammation. In such conditions it is wise, therefore, to support the joint by accurately moulded splints, by strapping, or by bandages. A well-made and softly padded leather splint is the most efficient support, and this should be removed daily for the application of a cold douche to the joint.

In chronic joint-diseases, when the interior of the joint is filled with granulation-tissue, this material surrounds and invades the ligaments, creeping in between and separating their fibres, and leading to their softening, degeneration, and eventual destruction. The result of this is that the bones become displaced in whatever direction the action of the muscles is predominant. This tendency to displacement must therefore be anticipated and provided against, in all cases of long-continued joint-disease, by the use of proper splints.

In rickets and other forms of debility the ligaments share in the weakness of the locomotive apparatus, which manifests itself in the occurrence of flat-foot, splayed-foot, knock-knee, lateral curvature of the spine, and other such distortions. The muscles failing in their weakness to hold the joints in position with firmness, undue stress is thrown upon the ligaments, the stretching of which gives rise to the aching pain which so commonly accompanies these affections, and which is sometimes mistaken for rheumatism.

PYÆMIC JOINT-DISEASE.—The affection of the joints most often met with in acute pyæmia is a rapidly progressive suppurative synovitis. The process is one of extreme acuteness and virulence; in no other form of joint-inflammation are the tissues involved so quickly destroyed. The joint may be found full of pus, and the cartilages extensively ulcerated, within forty-eight hours of the first sign of inflammation. The earliest symptom is usually swelling, which rapidly increases, and is soon followed by pain and heat. At this stage the synovial membrane is swollen and vascular, and the joint is filled with slightly turbid fluid. Soon the tissues around become œdematous, suppuration occurs, the cartilages ulcerate, and the joint is quickly disorganised.

Early aspiration should therefore be made; and, if the fluid be purulent, an incision must be made into the joint in such a position as will best ensure free drainage, the synovial cavity washed out with a mild antiseptic solution (e.g. carbolic acid in water, 1 to 80), and a drainage-tube left in the wound. It is of great importance to give exit to the matter at the earliest possible moment. As ankylosis is to be anticipated, every precaution must be taken to maintain the joint in the most useful position.

Besides this acute disease, there is also met with in association with the less virulent type of pyæmia, a more chronic and much less grave affection of the joint. This is characterised by a painful swelling of the joint, which rapidly attains its maximum, and which is attended with but little of the heat and tension that accompany the acute form. There is a milder degree of constitutional disturbance, and much less tendency to suppuration. In these cases several joints are often affected, the effusion subsiding in one as it appears in another, and gradually becoming of a less active character. Every degree is met with between the mildest form, in which there is an almost passive synovial effusion lasting only for a few days, and the severe and acute type above described. Among the diseases giving rise to the more chronic form of septic synovitis may be mentioned scarlatina, typhoid fever, gonorrhœa, and vaginitis. In these the effusion is generally not purulent, though often resulting in stiffness and adhesions, both intra- and extra-articular. Nevertheless, sometimes these same diseases give rise to the acutest form of the malady.

The local *treatment* will be the same as for ordinary synovitis, with the addition of whatever measures are needful to get rid of the source of the infection. Of medicines, quinine and sulphite of soda are the most useful; and, as in other septic diseases, a supporting plan of treatment is indicated.

RHEUMATIC SYNOVITIS may be acute or chronic. In the acute form it accompanies the characteristic fever, sweating, and other symptoms of rheumatism; it attacks chiefly the larger joints, and subsides with the diminution of the pyrexia. Not infrequently, however, in spite of the subsidence of the general disease, effusion and pain persist in one joint, and at this stage the case often comes under the treatment of the surgeon. Moreover, persons of rheumatic diathesis are liable to recurring synovitis of a subacute or chronic type, which has an obvious relation to their constitutional condition. These cases do not tend to suppuration, but very commonly lead to adhesions. In the acute form, rest, even pressure by cotton wool applied beneath an elastic bandage, or warm alkaline and opiate fomentations, are the appropriate local applications; in the chronic form, blisters, stimulant liniments, warm douches, and frictions.

The rheumatic tendency must also of course be treated (as by salicylates, alkalies, opium, and appropriate diet). In the later and chronic stage, 'rheumatic joints' are much benefited by Turkish baths, shampooing, and a residence in a dry, warm climate. *See* GONORRHŒAL RHEUMATISM.

CHRONIC RHEUMATIC ARTHRITIS, *see* under that heading and also OSTEO-ARTHRITIS.

GOUTY ARTHRITIS is an acute form of joint-inflammation characterised by extreme pain, rapid swelling both in and around the joint, œdema and redness of the skin, local heat, and a variable amount of pyrexia. It affects the smaller joints, especially the metatarso-phalangeal joint of the great toe, giving rise to deposits of urate of soda in the cartilages, ligaments, and adjoining structures. It occurs in persons of the uric acid diathesis, comes on usually after middle life, and is often inherited. Although gout is considered a medical rather than a surgical disease, and comes under the treatment of the physician, the surgeon will observe that many traumatic and other joint-affections, when they occur in persons of gouty habit, are considerably modified thereby; especially in the direction of chronicity and the deposit of urate of soda, with corresponding deformity and stiffness. The recovery of such cases will be aided by attention to the condition of the urine, and the judicious use of alkalies, colchicum, abstinence, and other remedies appropriate to the gouty state.

SYPHILITIC DISEASE OF JOINTS.—A not uncommon concomitant of the earlier secondary symptoms of syphilis is a transient synovial swelling, attended with aching pain and some heat in the part. The joint should be kept at rest while the swelling persists; under appropriate anti-syphilitic treatment recovery is usually complete.

A much more troublesome affection of the joints is that which occurs in the late stages of syphilis, and which consists in a gummatous infiltration of the synovial membrane or other joint-structures. This form of disease is of an indolent and persistent character. There is dull aching pain, often increasing at night, and there is irregular pulpy swelling, sometimes of the synovial membrane, sometimes of the soft tissues outside the joint, sometimes of the periosteum at the lower end of the bone. These growths may develop into fibrous thickenings and adhesions, or they may break down and ulcerate on to the surface or into the joint.

For *treatment*, the joint should be fixed by a splint, and full doses of iodide of potassium given, combined with tonics. The success of the treatment will depend much on the state of the patient's health; the condition is often met with in debilitated persons who will require the aid of good food, fresh air, and cod-liver oil. When the health has improved, much benefit is to be obtained from a mild course of mercury, especially the biniodide. Locally, the joint should be kept warm, but not otherwise stimulated.

A similar affection is sometimes met with in children about the age of puberty, who are the subjects of inherited syphilis. Infants suffering from inherited syphilis are liable to an epiphysial disease, which consists in an inflammation of the ossifying layer, giving rise to a separation of this layer, with the epiphysis, from the shaft of the bone. Several bones are usually attacked. *See* EPIPHYSES, Affections of.

The *symptoms* are a pseudo-paralysis of the affected limbs, and swellings at the position corresponding with the epiphysial line of some of the bones, most often the femur or humerus: later on, the epiphysis is felt loosened from the shaft, and there is probably fluid swelling around the end of the bone. There is an absence of any acute pain or marked pyrexia. The history, and usually some other symptoms, will be found to indicate the inheritance of syphilis.

If not very advanced the disease yields rapidly to mercurial treatment.

SCROFULOUS JOINT-DISEASE.—Scrofulous children are in a more than ordinary degree liable to chronic affections of the bones and joints. These affections have often a traumatic origin, but, occurring in scrofulous subjects, they exhibit a pertinacity and a tendency to degenerative changes less often met with in the healthy. But it must be remembered that there are other causes besides scrofula for the persistence of joint-diseases in children; as for example, lack of care, repeated injuries, and the physiological activity of the part; so that it is both inaccurate and confusing to apply the epithet 'scrofulous' to chronic joint-diseases unless they occur in connection with other signs of the scrofulous constitution. If, however, an indolent joint-inflammation is met with in combination with other symptoms of scrofula (e.g. glandular enlargements, chronic pulmonary, nasal, or intestinal catarrh, ophthalmia, persistent dermatitis), it is reasonable to assume that the joint-disease is of scrofulous origin. The most common forms of scrofulous joint-disease are chronic articular ostitis and pulpy degeneration of the synovial membrane (described above).

Either of these conditions occurring in a scrofulous subject is characterised by the extreme slowness and indolence of the process, and by the tendency of the inflammatory products to undergo retrogressive rather than developmental changes. Thus, in the bones the inflammatory cell-growth goes on very slowly, and is apt to lead to caseation and softening. So also the thickened synovial membrane shows much more tendency to fatty degeneration and suppuration than to fibrillation and cicatrization. Another marked peculiarity of scrofulous inflammations is the slightness of the pain and the small amount of pyrexia which accompany them. So that these scrofulous joint-diseases go slowly on for months and years; indolently, and often almost painlessly, progressing from slight and sometimes imperceptible beginnings, through gradually increasing swelling and softening of synovial membrane or joint-end of the bone, to ulceration of cartilages and yielding ligaments, displacement of the bones, and degradation of inflammatory products into ill-formed pus, and thus at last to destruction or permanent crippling of the joint. Yet if the child's health can be tended and improved, and if unlimited time can be given, many of these diseases at last come to an end. For scrofula is a disease of early life; it tends to wear itself out, and under improved hygienic conditions and appropriate remedies to disappear as the child gets older, though of course its effects may remain through life. Hunter said truly, 'Puberty often produces a cure.'

In the *treatment* of scrofulous joint-disease, therefore, the environment of the patient is of the greatest consequence, and every possible aid should be given towards improving the condition of nutrition and health. Long residence at elevated situations in bracing mountain air, or at the sea-side, is especially to be desired; and, when this cannot be obtained, as much as possible of sunlight and fresh air. Plenty of nourishing food, especially fatty foods, warm clothing, careful attention to the state of the digestive organs, early hours—all these are material aids in the treatment; of medicines, cod-liver oil and iodine are of the greatest value.

The local treatment must be in great measure determined by the general condition. As long as the health is improving, it is worth while to practise much perseverance in the management of the joint. A splint must be applied to maintain rest, and in the early stages counter-irritation by light touches of the actual cautery is of great use. If the synovial membrane is the seat of the disease, counter-irritation is to be followed by strapping over mercurial ointment, or some of the other measures described above (*see* above—section on *Chronic Synovitis*). If the bone is affected, regard must be had to any signs of central suppuration, calling for perforation or removal of sequestra. Even excision may often be permissible and successful after the health has been improved. But, if the general state of the patient is becoming deteriorated by the irritation of the local disease, amputation will probably be the wiser measure, for removal of the diseased limb is frequently followed by rapid recovery of the health.

TABETIC ARTHROPATHY.—M. Charcot has called attention to a form of joint-disease occurring in connection with locomotor ataxy, which he considers to be peculiar to that disease. The first symptom is usually a sudden effusion of fluid within the joint, without pain or fever. This may gradually become absorbed, but after a time recurs, and is followed by rapidly progressive degenerative changes in the cartilages and bones, which give rise to great alterations of shape, to crepitation, and to displacement of the joint-surfaces. An examination of such joints shows the bone-tissue to be rarified, the Haversian canals widened, and the fatty elements largely increased; the joint-surfaces greatly worn away, and the ligaments softened and stretched. The knee is most often affected, but similar changes have been found in the hip, shoulder, wrist, and tarsus. It will be observed that this affection closely resembles chronic rheumatoid arthritis, from which the chief anatomical distinction is said to be that there is less formation of new bone and greater destruction of the articular sufaces. It is indeed, by some observers considered to be osteo-arthritis, modified by its occurrence in an ataxic subject. But the clinical history seems to justify the separation of these cases into a separate class; the sudden and painless onset, the rapid destruction of the joint-surfaces, and the comparatively slight interference with movement, contrasting notably with the aching pain, the chronicity and the immobility of ordinary rheumatoid arthritis. *See* CHARCOT'S DISEASE.

HYSTERICAL JOINT-AFFECTIONS: *Neuromimesis.*—The nervous mimicry of joint-disease is amongst the most common manifestations of the neurotic or hysterical diathesis. Such cases often resemble very accurately the true disease, especially in the position assumed by the limb, in the rigidity of the adjacent muscles, and in the character of the pain. But it will be observed that there is usually some inconsistency in the symptoms. Thus, it may be noticed that the pain is out of all proportion to the other evidences of disease; that there is no heat or swelling about the joint even after weeks of acute suffering, neither is there the muscular wasting which would have occurred in bone-disease; that inter-articular pressure does not give pain, while any attempt at movement is at once complained of; or the symptoms may vary in a manner incompatible with organic disease. The aspect and family history of the patient, and an account of the manner in which the affection commenced and progressed, will usually help the diagnosis. Sir J. Paget has pointed out the close alliance of this condition with insanity and other disorders of the nervous system; and it will often be found on inquiry that there is an hereditary predisposition to nervous disease, and that the joint-affection has followed closely upon some mental strain or disturbance. In doubtful cases, the administration of ether will often decide the diagnosis; for in the mimic disease the joint can be moved with perfect freedom and smoothness directly the patient is unconscious, and the unnatural posture and rigidity are only resumed when consciousness has been fully recovered, instead of, as in real disease, immediately upon the slightest return of sensation. Neuromimesis is not confined to the female sex, though it is more common therein (the writer has recorded a well-marked case in a boy of eleven years); it prevails mostly in young persons, and among the upper classes.

The *treatment* of this condition must be directed towards the improvement of the tone and stability of the nervous system; for this it is essential that all undue strain and excitement should be avoided. The habits and employment should be regular and of even tenour, plenty of food and rest should be taken, and the patient withdrawn from sympathetic petting and the society of persons of similar temperament. Any functional disturbance, uterine or otherwise, must be attended to; constipation, which is often prevalent and interferes with nutrition, must be overcome by proper medicines and diet; and, if indicated, tonics —iron, zinc, arsenic, valerian, and the like —administered: shower-baths, shampooing, and mild gymnastics may also be found useful aids.

For local treatment the first essential is that all splints and apparatus of restraint be cast aside. The patient must be encouraged to use the joint, and the necessary effort of the will may be sometimes aided by proving the mobility of the joint by a sudden and unexpected movement of it. The administration of an anæsthetic will occasionally produce a cure. It must not be forgotten that persons of this mobile and sensitive condition of the nervous system suffer in an exaggerated degree from any real cause of pain; so that any cause, however slight and apparently inadequate, for their suffering should be sought for and removed. J. Warrington Haward.

JOINTS, Excision of.—The excision of a joint implies the removal of part or the whole of the articular surfaces of the bones concerned, in such a manner that fibrous union or osseous ankylosis may result. This is usually accomplished by means of an incision laying the joint freely open, through which the bones are cleared of soft parts and divided at a level corresponding to the extent of the disease or injury.

Excision may become necessary on account of (*a*) disease, (*b*) injury, or (*c*) ankylosis.

(*a*) The disease most commonly calling for excision of joints is chronic synovitis.

When pulpy degeneration of the synovial membrane has rendered a joint useless, excision is often the best method of treatment. This is especially so if there be ulceration of the cartilages and caries of the articular lamella, and if chronic suppuration has occurred. So also caries or necrosis of the articular surfaces, chronic articular ostitis, and abscess of the articular end of a bone opening into the joint, are conditions in which excision may be successfully resorted to. Excision may occasionally, though rarely, be desirable in cases of chronic rheumatic arthritis.

Cases of acute disease are not suitable for excision; neither is it wise, as a general rule, to resort to the operation in persons past the middle period of life. In considering the question of excision of a joint, it must be remembered that a successful result requires a good deal of reparative power on the part of the patient; that the operation itself, if upon a large joint, is one of some severity; and that, in the lower extremity it involves a more or less prolonged confinement to bed, and for a time complete immobility of the limb. So that for persons past the period of youth, or of broken-down constitution, or who are worn and weakened by prolonged suppuration, or who bear confinement badly, amputation is by far the safer operation. Excision is, moreover, inappropriate in cases complicated with visceral disease, such as tuberculosis, amyloid degeneration, or Bright's disease. Yet the so-called scrofulous constitution does not forbid the operation, partly because the subjects are children, and also because the morbid tendency may to a great extent be counteracted by treatment.

The size and function of the joint concerned must also be taken into account. The larger the joint, and the nearer to the trunk, the more serious is the operation. Then with regard to function: in the knee and ankle, excision leaves the limb in much the same condition as when ankylosis occurs without operation, with the disadvantage of some shortening on the side of excision. So also the natural cure of hip-disease often leads to as useful a limb as is obtained by excision. In the upper extremity, ankylosis of the shoulder is to a great extent compensated for by increased mobility of the scapula; but a stiff elbow-joint is so much less useful than a moveable one, and excision of the joint is so successful that the argument is much more often in favour of excision than of the other alternatives. The extent of the disease is also of much importance in deciding the question. For the complete removal of the diseased parts by excision would, in some cases, involve an amount of shortening which would leave a useless limb; while in other instances, in which the bones could be successfully treated, the soft parts may be so extensively destroyed or undermined by suppuration as to preclude the probability of a satisfactory amount of repair.

Here again, however, it must be borne in mind that in situations where a moveable joint is desired, as in the hip, shoulder, and elbow, much more bone may be removed than if a stiff joint is the result aimed at, as in the knee. It is always desirable, if possible, to avoid dividing the bones beyond the epiphysial junction, both because of the increased danger when the medullary canal is opened, and because of the interference with the subsequent growth of the bone in young persons. The presence of sinuses leading to the diseased bone need not interfere with a successful excision; but these canals, as well as any abscess-cavities in connection with the joint, should be scraped out with a Volkmann's spoon, or freely cleansed with a solution of chloride of zinc.

(*b*) Excision may be required in consequence of severe injury to a joint, such as compound comminuted fracture or gunshot wound. Here again, the decision concerning the operation must be based upon the same general principles as have been enunciated above with regard to excision for disease. The health of the patient, the size and function of the joint, the nature and extent of the injury, must all be carefully considered, as well as the possibility of obtaining the requisite care and nursing during the after-treatment. It will be obvious that the conditions, under which military surgery is usually practised, are not such as to admit of excisions of the joints of the lower extremity being performed with much chance of success. *See* GUNSHOT WOUNDS.

(*c*) Excision is also performed in cases of ankylosis, either for the purpose of improving the position of the limb or for obtaining movement by a false joint. In the upper extremity, excision of the elbow may be very properly resorted to in young and healthy subjects, to avoid the inconvenience of a stiff joint. In the knee, it would, of course, only be called for when the ankylosis has occurred in the flexed position. In the hip-joint, such a condition should be treated, not by excision, but by division of the neck or shaft of the femur.

The operation will of course vary with each particular joint, but the general principle is that the sections of the bones should be made at such points as will ensure the removal of the diseased articular surface, with as little interference as possible with the epiphysial junction or the shaft of the bone. The incision through the soft parts should be so arranged as to give free access to the joint; the extent of the disease should then be accurately ascertained, and a corresponding amount of bone removed by an even section. Diseased synovial membrane and granulation-tissue should then be dissected out or scraped away, sinuses cleansed, and the whole wound rendered aseptic; finally, the bones must be placed in an appropriate position, a drainage-tube inserted, and the wound in the soft parts closed by sutures. The dressings should be of antiseptic material, and the splints or other apparatus of restraint be so arranged as to allow of the dressing of the wound, with as little disturbance of the limb as possible. A dressing of dry carbolized wool appears to the writer to have the great advantage in this, as in many other operations, of absorbing discharge, of keeping up gentle elastic pressure on the part, and thus preventing oozing of blood and maintaining the wound in accurate apposition, and of an even temperature.

The subperiosteal method of excision has been advocated by M. Ollier and others, who claim for it the advantage that there is a more complete reproduction of the excised portions of bone, and that the attachments of the muscles around the joint are less interfered with than by the ordinary operation. The principle of the method is to cut down upon the ends of the bones entering into the joint, making the incision as far as possible parallel to the axis of the bone, then to separate the periosteum with the attached tendons and ligaments by the insertion of appropriate raspatories between it and the bone, and finally to divide the bone, either by turning it out of the wound or by passing round it a chain saw.

The operation is troublesome and tedious, and the separated periosteum does not always survive; if it does, however, there is doubtless usually an abundant production of new bone, more or less resembling in shape that which has been removed. But this is not always an advantage; for instance, in the case of the elbow, the irregular growth of new bone may be an impediment to the free movement of the new joint; and it is doubtful whether, in the majority of cases, any distinct gain results from the adoption of the subperiosteal operation as applied to joints. When, however, any large portion of the shaft of the bone has to be removed as well as its articular surface, it is very desirable to leave as much as possible of the periosteal sheath (which in such cases is often easily separable), so as to provide for the more complete regeneration of the excised bone, and obviate excessive shortening or flail-like union.

The after-treatment of joint-excisions must be directed to the maintenance of the nutrition of the patient and the promotion of the rapid healing of the wound. The larger excisions involve considerable shock, and make large demands upon the reparative powers, so that plenty of nourishing and digestible food should be given from the first. As much fresh air and sunlight as possible should be admitted to the room; and, in the case of the upper extremity, the patient should not be kept in bed longer than is absolutely necessary. The wound must be kept aseptic and at rest, that there may be as little formation of cicatricial tissue as possible. When, as in the knee, ankylosis of the bones is desired, absolute immobility must be maintained during the process of union, and the part supported afterwards by a proper splint. When a false joint is required, as in the hip and elbow, passive movement must be practised as soon as the healing is sufficiently advanced.

Excision of the Ankle.—This operation involves the removal of the articular surface of the tibia and fibula, and of the upper surface of the astragalus. It is practised both for injury and disease.

The cases of *injury* which admit of this operation are not numerous, for usually, if the bones of the ankle-joint are sufficiently comminuted to require resection, the soft parts are also so much damaged as to necessitate amputation. Nevertheless, some gunshot wounds and compound fractures of the ankle are met with, in which the main vessels and nerves have escaped, and in which the stress of the injury has fallen upon the bones; and in such cases, if occurring in young and healthy persons, resection should certainly be attempted.

With regard to *disease*, also, it must be admitted that, although chronic affections of the ankle-joint are sufficiently common, yet that cases to which excision can hopefully be applied are not very often met with. For, the chronic diseases of the synovial membrane and bones, which are so prevalent in this situation, are seldom limited to the ankle-joint proper, but commonly affect the bones and joints of the tarsus also. Yet we do meet with instances in which the disease is of traumatic origin, and occurs in subjects of otherwise good health, and in which the mischief is confined to the limits of the ankle-joint, and has not spread beyond the surfaces of the tibia and astragalus. These are the cases to which the operation of excision is most properly applicable.

The *operation*, as devised by Mr. Hancock, is performed as follows:—Esmarch's bandage having been applied, an incision is made over the outer ankle, commencing three inches above the tip of the malleolus, and running down the posterior border of the fibula as far as its point, and then passing forwards to within half an inch of the base of the fifth metatarsal bone. The flap thus marked out being dissected forwards, the fibula is divided with cutting forceps, and its lower two inches removed, the peronei tendons being left uncut. A similar angular flap is next turned up over the inner ankle, the incision running from three inches above the malleolus along the posterior border of the bone, and as far forwards as the inner cuneiform bone. The knife must be kept close to the bone, so as to avoid the posterior tibial vessels and nerve. The internal lateral ligament is then divided close to the tibia, and the foot twisted outwards so that the astragalus and tibia present at the inner wound. A narrow-bladed saw is then introduced through the inner wound and projects at the outer, and by this means the lower end of the tibia and the upper surface of the astragalus are sawn off.

The bones are then brought together so that the tibia and astragalus may become ankylosed, a drainage-tube introduced, and the wounds closed by sutures. The limb is then placed on a splint with the foot at a right angle to the leg. If the astragalus be found extensively diseased, the operation may be modified to the extent of removing all the bone instead of only its upper part; and in cases of injury, the amount of bone removed and the line of incision must of course be altered to suit the exigencies of the case. Repair after the operation is often slow, but in successful cases a most useful foot is left.

Excision of the Elbow.—This operation is required in cases of compound comminuted fracture, and in gunshot wounds of the elbow, in chronic disease of the joint, and in certain forms of bony ankylosis. In severe compound fractures, in which the lower end of the humerus is comminuted, the filling up of the fossæ into which the ulna plays is a common cause of impaired movement, so that a more useful limb is usually to be obtained by excision. When ankylosis has occurred in a useless or inconvenient position, or when it is desired to regain the movements of a fixed joint, excision may be undertaken with every prospect of success. Excision of the elbow is most often required, however, for chronic suppuration of the joint with ulceration of the articular surfaces of the bones, the result of degenerative synovitis, or articular ostitis.

Operation.—The joint is to be opened on its posterior aspect, either by a single longitudinal incision, or by a combination of this with a transverse incision made at right angles from its centre.

In cases in which there is very great peri-articular thickening, it may be convenient to adopt the method practised by Mr. Syme of making a longitudinal incision on each side of the back of the joint, joined by another across the upper border of the olecranon. In the majority of cases the single incision is sufficient. It should be made parallel to the outer border of the ulna, directly down to the bones, and be of sufficient length to allow of the soft parts being dissected off, and the bones protruded as far as their removal is intended. The joint should be opened just above the olecranon, and the condyles of the humerus carefully cleared by dissecting close to the bone.

Care must be taken to avoid injury to the ulnar nerve, which should be raised with the surrounding tissues from the groove between the internal condyle and the olecranon process, and drawn with the soft parts to the inner side of the condyle. In excisions for disease the nerve is not usually seen, as it is embedded in the adjacent thickened cellular tissue.

The lateral ligaments should next be divided, the forearm flexed, and the ends of the bones thrust out of the joint and sawn off. The ulna should first be divided at the level of the coronoid process, leaving the base of the process when possible; then the head of the radius is cut off, and lastly the humerus sawn through just above the condyles. Or, many surgeons prefer to remove only the olecranon process, thus gaining ready access to the interior of the joint. The lateral ligaments are then divided, the coronoid process and head of the radius sawn at the same level, and lastly the condyles removed through the supra-condyloid fossæ.

The wound should then be sewn together excepting where a drainage-tube is inserted, dry antiseptic dressings applied, and the limb placed upon an internal angular splint, or in the straight position on a pillow.

In the subperiosteal method, the bones having been freely exposed, the periosteum, with the attached tendons, is carefully separated with raspatories from the portion to be removed. The ulna is treated first, then the radius, and lastly the end of the humerus. There is nothing, however, to show that the results of this tedious proceeding are in any way superior to those obtained by the ordinary method; while, on the other hand, there are cases on record which prove that the reproduction of bone after the subperiosteal operation may be a distinct disadvantage, by interfering with the freedom of movement in the new joint.

Seeing that fibrous union is desired after excision of the elbow, a good deal of bone may be removed without interfering with eventual success; but the amount indicated above is that which is followed by the most satisfactory result, and is usually found to include the whole of the disease. If less is removed the movement obtained is apt to be limited; while, if more is taken away, the process of repair is less perfect, and a much longer time elapses before the muscles shorten sufficiently to act efficiently upon the forearm. Nevertheless, if the bones be extensively diseased, the surgeon may venture upon a more free excision in this than in most other joints; and the writer has seen what seemed, for several months, to be a flail-like union after excision eventually result in a perfectly efficient joint, with a limb as useful as that of the opposite side. It is well, therefore, to have patience with such cases, giving time for the muscular shortening to draw the bones together; and, should the disease recur, even to perform a re-excision rather than sacrifice the arm.

In the after-treatment of excision of the elbow the limb should be kept at rest till the wound is healed or nearly so; but at the end of three or four weeks it is well in most cases to begin passive movement. When more bone than usual has been removed, it is of course desirable to maintain rest for a longer period. The patient need not be kept in bed after the first week or two. The results of excision of the elbow are usually most satisfactory, an excellent false-joint being formed and very perfect movement obtained.

Excision of the Hip-joint. *See* Hip-disease.

Excision of the Knee.—Excision of the knee-joint is performed chiefly for chronic suppuration or pulpy degeneration of the synovial membrane, caries of the joint-surfaces, or chronic articular ostitis. It is also occasionally required in cases in which ankylosis has been allowed to occur, with the limb in a flexed position.

For *injury*, the operation is seldom practised. In the gunshot wounds of military practice the condition of the limb and the environment of the patient are seldom such as are necessary for a satisfactory recovery from excision of the knee; and in civil practice very few injuries of the joint are met with which, if they are of sufficient severity to call for operation, are not also too extensive to allow of successful excision. Primary excision of the knee, it must be remembered, is a very severe operation, requiring much greater reparative power than amputation, and only applicable, even when the local conditions are suitable, to the young and healthy.

For chronic *disease*, however, when limited chiefly to the synovial membrane, or affecting the bones only to a superficial extent, excision of the knee may often be advantageously preferred to amputation in young subjects, as a means of preserving a limb which, though ankylosed, may yet be very useful both for progression and support. Here again, however, it must be borne in mind that the operation is one of considerably greater severity than amputation, and requiring for its success a much greater amount of reparative power and a much longer period of careful after-treatment. The operation is therefore not suitable in persons past middle age, and seldom in those past youth; nor in those whose health has been exhausted by prolonged suppuration or pain; nor in cases of serious visceral disease, as tuberculosis or amyloid degeneration. Nor should it be attempted in any acute disease.

Operation.—This consists in freely laying open the joint at the front and sides, dividing the ligaments, and exposing the articular surfaces of the bones, so that a slice can be sawn off the femur and tibia, leaving two even surfaces of healthy bone to become ankylosed, with the limb in a straight position.

The most convenient incision is one commencing over the posterior part of one condyle, and extending in a curved direction across the front of the joint below the patella, to a corresponding point over the other condyle. This should divide the integument only, which should be dissected back from the patella and the front of the joint. The joint should then be freely opened by dividing the ligamentum patellæ and the lateral ligaments, while an assistant forcibly flexes the limb and thrusts the bones upwards out of the wound. The knife is then to be carried round the femur at the level at which the bone is to be divided, the blade being kept close to the bone and guided by the finger, and a slice of the bone is to be sawn off. The bone is to be sawn from before backwards and at right angles to the long axis of the shaft; and not more than about half the cartilaginous surface is to be removed, or the epiphysis would be encroached upon. The head of the tibia is then similarly cleared, so as to allow of its articular surface being sawn off just below the cartilage, the section also being kept carefully at a right angle with the shaft of the bone.

In using the knife or saw towards the posterior part of the joint, care must of course be taken to avoid injury to the popliteal artery, which is only separated from the bone by a small quantity of loose cellular tissue; the best protection against injury of the vessel being to have the bones thrust well upwards out of the wound. An ordinary amputation-saw may be used, and the bones be steadied by the lion-forceps. The patella is then removed and the diseased synovial membrane dissected or scraped away; after which the bones are to be carefully adjusted with the cut surfaces in even apposition, the soft parts brought together by sutures, a drainage-tube inserted, and the limb bandaged to an appropriate splint. All this should be done, and the patient placed in bed with the limb suitably supported and fixed, before the anæsthetic is discontinued.

The operation has been variously modified from the description here given. The transverse incision may be altered to two lateral ones joined by a third across the front of the joint, or a long semilunar flap may be turned back from the front of the joint; or again, the operation has been completed through the lateral incisions alone, the patella, with the attachment of the quadriceps, being left intact (Jones of Jersey). Another method is to saw through the patella transversely, and turn each half of the bone up or down with the adjacent soft parts; the operation being then completed in the usual manner, the cut surfaces of the patella are sutured together, the integuments adjusted, and the bone left in position (Golding-Bird). The writer believes, however, that in the majority of cases it is better to remove the patella.

Whatever method is adopted, the operation should be performed with antiseptic precautions, and every care taken to maintain the bones in accurate apposition and at perfect rest, so that firm bony union may be obtained. A variety of splints has been invented for application after excision of the knee. That most commonly in use is a metal splint with foot-piece for the back of the limb, to which can be fixed a bracketed side splint. A short anterior splint for the thigh is also sometimes a useful addition. Or the limb may be put up in a paraffine or gypsum bandage, enclosing a posterior light wooden splint and an anterior suspension rod. The splint and dressings should be so arranged, that the wound can receive the necessary attention without disturbance to the position of the limb.

The operation is a severe one, and is usually attended with considerable shock; so that in young and irritable subjects the free administration of opium is often desirable for a few days afterwards. The reparative powers must be assisted by a liberal diet, as much fresh air and sunlight as posssible, and, if needful, tonics and stimulants. In successful cases bony ankylosis occurs, but is not usually firm till about six months have elapsed. When the use of the limb is resumed, a leather splint strengthened by light metal plates at the back and sides must be worn for support, and an addition must be made to the sole of the boot to compensate for the shortening.

Excision of the Shoulder. — This operation is practised chiefly for chronic joint-disease, but may also be applicable to some cases of severe injury of the joint, such as gunshot wounds and compound fractures.

In *injuries* opening the shoulder-joint and involving severe comminution of the bones, it may be possible to remove loose fragments without sacrificing the entire head of the humerus; and it must be borne in mind in the treatment of such cases, that ankylosis of the shoulder leaves a more useful limb than usually results after excision of this joint. Nevertheless, in gunshot wounds and compound dislocations, if the head of the humerus be severely crushed, the complete excision of the injured portion of bone may save a long period of suppuration and separation of necrosing fragments.

For *disease* of the shoulder-joint, the removal of the head of the humerus is usually all that is needful, for the glenoid cavity is often only superficially affected, and may be treated by scraping, or left untouched. The condition for which the operation is most commonly performed is chronic suppuration of the joint, with ulceration of the cartilages and caries of the articular surface of the humerus, which has originated either in degenerative synovitis or in chronic articular ostitis.

Operation.—In ordinary cases, the joint can be conveniently exposed by a long straight incision, starting from the point of the acromion process (or, as preferred by some operators, close to the outer side of the coracoid process), and passing downwards over the head of the bone and a few inches along the shaft. The knife should pass directly down to the bone, and the soft parts, including the long tendon of the biceps, being held aside with retractors, the humerus should be rotated first outwards and then inwards to allow of the division of the muscles attached to the two tuberosities. This having been done, the head of the bone can be protruded through the wound and removed by the saw to whatever extent seems necessary, usually below the tuberosities.

The articular surface of the scapula should then be examined, and, if deeply diseased, may be removed by a narrow-bladed saw, such as is used for dividing the neck of the femur, or by strong cutting-forceps. This, however, should be avoided if possible and is seldom needful, for the disease is mostly confined to the head of the humerus; but any granulation-tissue or diseased synovial membrane adhering to the glenoid cavity should be scraped away with a Volkmann's spoon. In this, as in other excisions, a convenient protection to the soft parts when the bone is being sawn, is a strong curved steel director, made for the purpose, which is passed under the bone to be divided, and then turned, by means of a hinged handle, with its groove upwards towards the saw.

If, however, the head of the humerus be much enlarged, or there be abscesses or sinuses which require to be laid open, the first incision may be modified accordingly. For instance, a semilunar flap may be cut through the deltoid over the outer aspect of the joint, and the operation completed by the division of the muscles attached to the tuberosities, and the removal of the head of the bone in the manner described above. Or the joint may be opened posteriorly by an incision, starting from just behind the acromion and curving downwards and outwards, but stopping short of the bicipital groove and its tendon, which latter may be preserved if entire, as it seldom is in cases of disease.

For the subperiosteal method as practised by M. Ollier, a longitudinal incision is made down to the bone through the anterior part of the deltoid, a little behind the cephalic vein. The periosteum, with the tendons and other soft parts, is then separated from the bone by raspatories as low down as the section is intended to be made; the bone is then protruded from the wound and sawn through.

The divided vessels having been secured, and the wound rendered aseptic, a drainage tube should be inserted and the wound closed by sutures except at its most dependent part. After the dressings have been applied, a pad should be fixed in the axilla to prevent inward displacement of the bone; and when the patient is up, the arm must be supported in a sling. In successful cases a very useful arm is left, most of the movements excepting abduction being fairly performed. The arm cannot be raised above a right angle to the trunk, but the deltoid often regains considerable power of lifting it from the side.

Excision of the Wrist-joint.—This operation consists in the removal of the articular surface of the radius and ulna, the carpal bones, and the carpal ends of the metacarpal bones; and is practised in cases of caries and suppuration of those joints. The instances, however, to which this operation is applicable are not very numerous, for, in the majority of cases of extensive disease of the carpus, the soft parts are so immediately damaged, the tendons so matted together or destroyed, and the suppuration so diffused, that there is no prospect of obtaining a useful hand. Nevertheless, considering the importance of preserving, if possible, even a somewhat disabled hand, it is worth while to attempt the operation whenever there seems a reasonable probability of success; and especially as the results obtained by the method of operating introduced by Sir Joseph Lister are in successful cases very satisfactory. The operation is a tedious and somewhat severe one, requiring a long period of subsequent repair, and its success will depend very much upon careful and constant attention to the after-treatment.

The method of Professor Lister is as follows:—An Esmarch's bandage having been applied, lateral incisions are made in such a manner as to allow of the removal of the bones with as little injury of the tendons as possible.

The incision on the radial side commences on the dorsal aspect of the radius, on a level with the base of the styloid process; thence it passes towards the inner side of the metacarpo-phalangeal joint of the thumb, running parallel and internal to the tendon of the extensor secundi internodii pollicis; but, on reaching the radial border of the metacarpal bone of the index finger, it diverges at an obtuse angle, and is continued downwards along the border of that bone for half its length. In this way the incision avoids on the inner side the extensor of the index finger, and on the outer side the radial artery and the extensor of the thumb.

The soft parts on the radial side are next carefully detached, and the tendons of the extensor carpi radialis longior and brevior divided at their insertions. These, together with the extensor secundi and the radial artery, are then pushed towards the radial side and the outer bones of the carpus exposed. The connections of the trapezium with the adjacent bones are then severed with the cutting forceps, and the soft parts on the ulnar side of the incision raised from the carpus as far as convenient. The ulnar incision is next made along the subcutaneous margin of the bone, extending from two inches above the styloid process downwards, between the tendons of the extensor and flexor carpi ulnaris, as far as the middle of the fifth metacarpal bone. The tissues on the dorsum are then raised through this incision, and the tendon of the extensor carpi ulnaris is cut close to its insertion into the fifth metacarpal bone. The extensor tendons of the fingers are next raised from the carpus, but not divided, and the dorsal and internal lateral ligaments of the wrist divided. The anterior surface of the ulna is now cleared by dissecting close to the bone, the pisiform bone with the tendon of the flexor carpi ulnaris being separated from the rest of the carpus, and the hooked process of the unciform bone cut off with the bone-forceps. The flexor tendons having thus been raised, the anterior ligaments are divided and the carpal bones extracted with sequestrum forceps. The articular surfaces of the ulna and radius are next sawn off, the bones being pushed out of the lateral wounds, and then the bases of the metacarpal bones are removed by the cutting pliers.

The trapezium is now dissected out, care being taken to avoid injury to the radial artery and the tendon of the flexor carpi radialis; and then the metacarpal bone of the thumb is pushed up and its articular surface cut off. Lastly, the cartilaginous surface of the pisiform bone is removed, the rest of the bone, if healthy, being left, as well as the hooked process of the unciform.

During the after-treatment, besides attention to free drainage of the wound, it is most important to keep up passive movement of the fingers, to prevent the stiffness which would otherwise ensue. Before the commencement of the operation, and while the patient is under an anæsthetic, the adhesions of the tendons which are usually present should be broken down as far as possible. Systematic passive movement of each joint of the fingers should be commenced within a few days of the operation.

Sir Joseph Lister advises the use of a splint with a wedge of cork to raise the palm of the hand, so that the fingers can be exercised without removing the splint. As the parts consolidate, the wrist also should be moved and voluntary motion be encouraged; and when the wounds have healed, an elastic bandage may be worn for a term to give support to the wrist.

J. Warrington Haward.

JOINTS, Wounds of.—A wound of a joint may have a direct communication with the surface of the body, and be in this way exposed to contamination by particles floating in the atmosphere; or it may be subcutaneous, and thus protected from external influence. Between these two classes of injury there is a very marked distinction —one which the older surgeons did not fail to recognise, though they attributed the serious results of an exposed wound to the influence of the air itself, and not to the ferment-causing particles with which an impure atmosphere is loaded. A dislocation is perhaps as good an illustration of a subcutaneous wound of a joint as can be given; for when this form of injury is complete, it often happens that every ligament of the joint is ruptured, the articular surfaces are displaced and lie in contact with structures with which they have no natural affinities, the synovial membrane is torn and bleeding, the muscles in the neighbourhood are lacerated, tendons displaced, and vessels and nerves often seriously damaged. Yet, after all this disturbance of a joint and its environment, it often happens that, following reduction, no acute inflammation occurs, there is no general rise of temperature, and the severed parts reunite and readapt themselves to their normal functions in a marvellously short space of time.

Very different is the result when some small instrument has penetrated a joint, and exposed the surface of the delicate synovial membrane to the influence of a ferment-exciting or putrescent material. We then have developed all the symptoms usually described under the term *acute traumatic arthritis*, but, perhaps, more correctly named *septic arthritis*. A severe sickening pain is experienced by the patient, and the joint rapidly becomes swollen and, later, red. After some hours, when the joint has become distended with fluid, the pain becomes acute and throbbing in character, and severe constitutional symptoms begin to manifest themselves. The temperature rises rapidly, and the patient becomes restless and anxious. He loses appetite and may vomit his food; his tongue becomes furred, his pulse rapid, and his urine scanty and high-coloured. If the communication with the joint remain patent, the clear viscid synovia, which at first escapes, is followed by a more watery fluid accompanied by flakes of lymph, then by sero-pus, and later by pus. When pus is present in the joint the skin over it becomes œdematous and of a more dusky red, and the superficial veins become distended. Rigors, followed by a temperature of 103° to 105° F., and then profuse perspiration, may also occur, and the patient is in the greatest danger from general septicæmia. If relief be not given by free incisions, the distended capsule yields at its weakest points, and the pus burrows among the muscles and in the cellular tissue around the joint, tending to make its way towards the surface. Should the patient escape death from general pyæmia, he will be exposed for many months to the exhausting influence of prolonged suppuration and its accompanying dangers, and at last may recover with an ankylosed joint.

The *pathological changes* which take place in a joint thus injured are first evident in the synovial membrane, which becomes injected and red, whilst its fringes are swollen and turgid; its surface soon loses lustre, and its cavity becomes filled with a watery, opalescent fluid containing lymph-flakes, leucocytes, and bacteria. The further progress of the inflammation is characterised by the rapid growth and intense vascularity of the synovial membrane, which brings it into strong contrast with the slow-growing œdematous granulations present in pulpy disease. Under its influence the cartilaginous surfaces become quickly destroyed, leaving at first, here and there, isolated portions of apparently healthy cartilage. The granulations developed in the joint in the later stages may be coated with a greyish lymph, giving them a sloughy appearance, and the interior of the joint is then bathed with pus. The ligaments, as the result of the inflammation, become softened and, under the influence of the muscles, may give way and allow of dislocation. The cartilage is also in part removed by granulations springing up from the bone. For a time the joint may be an abscess-cavity lined throughout with granulations; then these meet, interlace, and unite, becoming converted first into fibrous tissue, then into bone, as a result of which process ankylosis is effected.

Not every open wound of a joint is followed by the acute septic inflammation described, and the milder type of inflammation which frequently occurs bears some relation to the nature of the wound inflicted, but depends mainly upon the absence of infection by impurities in the air or on the penetrating instrument. It has long been known that a clean incised wound may be made into the knee-joint for the purpose of removing a loose cartilage, and that, with care, primary union may be obtained and little or no synovitis follow. An even severer test is the operation devised by Ogston for knock-knee, wherein a narrow saw is introduced into the knee-joint and the internal condyle sawn off. The joint becomes a receptacle for blood and bone-dust, yet rarely inflames severely as a consequence. The writer has sawn off the internal condyle of both knees of a patient on the same day, and the temperature during repair has not risen above 100° F. The free incision of the knee-joint, made for the purpose of wiring a fractured patella, may be also cited in illustration of the difference between an aseptic and septic wound of a large joint. Lacerated and bullet wounds of joints are among the most serious, inasmuch as primary union in these cases is almost impossible, and suppuration or sloughing of the skin-edges will almost certainly convey septic matter to the interior of the joint. The addition of splintered fractures, which often complicate gunshot injuries, renders these even more dangerous and difficult to treat.

A large wound of a joint is not necessarily more grave than a smaller one, even when primary union cannot be obtained; for a wound of considerable extent allows of freer drainage, which is one of the most important considerations should acute inflammation follow. When acute traumatic arthritis has set in, the size of the joint will be found to bear a definite relation to the amount of constitutional disturbance excited; and when prolonged suppuration results, childhood or youth will bear the strain better than adult life or old age.

The *diagnosis* of a wound of a joint may be made by noting the escape of viscid synovial fluid, by the exposure of articular cartilage, or by the depth to which a wound over a joint is found to penetrate. The first sign alone is usually sufficient, but a wound of a bursa in the vicinity may lead to error, as when the ligamentum patellæ is partially divided and the bursa behind it opened. Exposure of cartilage requires no comment; but the advisability of probing a wound to ascertain if it has penetrated the capsule is at least doubtful, and should be performed with great caution. It cannot be too strongly insisted upon that the probe should be disinfected before being used, and, in the presence of bad air, when no spray is at hand, it may be well to drop some disinfectant fluid from a sponge over the wound during the probing, to sterilise any air which may tend to enter. If the wound be large and it be a question of foreign body or splintered bone, the finger, first dipped in some disinfectant fluid, is a far better instrument for determining the nature of the injury than any probe.

The *treatment* of wounds of joints depends largely upon their character and extent, but, in every case, it may be insisted upon that complete fixation and rest upon a splint are among the most essential provisions for favouring recovery. The form of splint employed will vary with the practice of the surgeon, and in simple cases will matter little; but the writer is strongly of opinion that the splint, padding, and bandages should be so arranged that, in the event of suppuration, no change need be made. It is well, therefore, to fix the limb from the first upon a metal splint lined with waxed lint and secured with waxed bandages, that in the event of suppuration they may not be soaked with discharge, and thus become a hot-bed of decomposition. A small, clean, incised wound will often heal immediately under a pad of lint dipped in the old-fashioned antiseptic—compound tincture of benzoin. It is advisable, when trusting to simple remedies, to place over the joint an ice-bag or a Leiter's coil to lessen the tendency to inflammation. An incision of larger size may be brought together by fine wire stitches, and a piece of green protective and carbolised gauze dressings may be applied over the wound; these can be removed at any time under the spray, for the purpose of taking out stitches or securing drainage. Should the wound be soiled at all with dirt, the greatest care should be taken in cleansing it with an antiseptic lotion, and in gently syringing away any adherent particles. The wound in this case should only be closed at the upper part, the lower being left open for drainage, and antiseptic dressings should be employed. When it is clear that the joint has been exposed to contamination through a lacerated or contused wound of considerable extent, some more thorough means should be resorted to for allaying, as much as possible, the inflammation which may be anticipated. The joint should be thoroughly syringed out with a five per cent. solution of carbolic lotion, and counter-openings should be made at the most dependent spot on either side of the joint for the insertion of drainage-tubes. The whole should then be covered with antiseptic dressings, which should be reapplied every day, or whenever the discharge may have soaked through them. The drainage-tubes may often be removed in five or six days, but, if the discharge be profuse, they should be retained until it lessens. In any case, where acute suppuration with high fever follows a wound of a joint, free and dependent incisions should be made to allow of the escape of pus.

There are other cases of wounds of joints where the surgeon cannot hope to save the articulation, and in which he will have to decide between excision and amputation. Extensive laceration of the soft parts around an open joint will generally call for amputation, but the age of the patient has a strong determining influence in many cases where excision is practicable. It must be here remarked, that excisions for injuries of joints do not run the same even course towards recovery that excisions for disease may be expected to follow, and this is mainly due to the lacerated and bruised tissues having already become contaminated with living organisms. Hence a good deal of suppuration is apt to follow, and the surgeon has a difficulty in keeping the wounds sweet. To expose an old person to this exhausting process can never be advisable, and, therefore, after the middle period of life, there are few cases in which excision can be adopted in preference to amputation. How far fractures complicating the wound will weigh on the side of amputation or excision, may sometimes be decided by the position of the joint. Thus, at the knee, should there be much comminution, after the removal of the fragments it may be impossible to adapt the ends of bone so as to obtain the necessary ankylosis; whereas at the elbow the usual treatment after excision is directed towards the avoidance of ankylosis, and great sacrifices of bone may be made to save the hand, even though the arm remain a flail.

In the general treatment of a wounded joint there is much that requires attention. The diet during the early inflammatory stages should be light, nutritious, and unstimulating; whilst in the later stages stimulants may be freely administered and a liberal diet be given, to support the patient's strength whilst suppuration is proceeding. In the inflammatory period an effervescing saline mixture is of advantage to the patient, and in the later stages quinine and iron are of service; but opium is the drug which gives the patient most relief, and is almost essential to procure for him the necessary rest. A hypodermic injection of a quarter or a third of a grain of morphia may be given every night till the pain subsides. Chloral and bromide of potassium may occasionally be used as substitutes, but they are, as a rule, less to be relied upon than opium.

R. Clement Lucas.

JUGULAR VEIN, EXTERNAL, Venesection of the. *See* Venesection.

JUGULAR VEINS, Wounds of the, may complicate homicidal or accidental injuries of the neck, or may occur during operations upon tumours, &c. Those of the internal jugular are most important. They may prove fatal from the loss of blood, the admission of air, or, at a later stage, from purulent infection through detached clots. Occasionally, after passing a tenaculum through both edges of a small wound in this vessel, surgeons have successfully applied a ligature round a portion only of its circumference. But it is better to pass an aneurism needle beneath the vein, and, having surrounded it with a double ligature of silk or catgut, to tie one part above and the other below the opening. There appears to be no danger from the disturbance of the cerebral circulation thus produced, and the risk of thrombi being carried into the circulation is very much diminished by this mode of treatment. A wound of the anterior or external jugular vein usually requires only the pressure of a small pad; but, if it is made during the course of an operation, it is prudent to ligature the vein above and below the wound. N. Davies-Colley.

JUNKS.—The junk proper consists of a thin cushion measuring, for an adult, 26 inches by 15 inches, stuffed moderately firmly with horsehair, and, when new, about 2 inches thick. To prevent displacement of the stuffing whilst in use, the cushion must be sewn through or 'tufted,' to employ the technical term. The cover is best made of ticking. The cushion can be strengthened, if necessary, by longitudinal strips of cane sewn into the cover on its outer side, and, thus made, forms a strong splint for the leg, especially useful in military surgery. The apparatus is completed by the cover, which consists of a piece of strong calico or cloth ('loom linen sheeting,' specially made in Dundee for hospital purposes, is the best material), measuring 26 inches by 16 inches. Two cylindrical pieces of stick or thick cane, 22 inches in length and 1 inch in diameter, are sewn into the edges as in an ordinary 'wringing' contrivance. The cover is retained in position by two straps or webbings, encircling the whole apparatus.

The leg is placed in the junk, the lower end of the cushion projecting a few inches beyond the heel; the cover is placed outside the cushion, which is then bent up into the form of a trough, when completed, by buckling the straps. The foot usually requires some support. This junk is well adapted for the treatment of sprained ankle, fractured fibula, fractures of the leg with much swelling, or as a fixation apparatus for 'first treatment' of fractures, or when it is necessary to transport the patient. It has the disadvantage of being rather hot, and is apt to get foul if used for cases where there is much discharge. A pillow and a piece of common sheeting make a very efficient roll junk on an emergency.

The ordinary junks are merely flat cushions, measuring (for adults) 28 inches by 16 inches, and, when newly stuffed with horsehair, from 4 inches to 6 inches thick. They are best covered with strong ticking and should be tufted. These junks are used to keep limbs raised, and are usually placed, wrapped in a draw-sheet, under the injured part, but often are more comfortable when placed beneath the mattress. When used for cases in which there is much discharge they should be wrapped in macintosh sheeting.

A special and very useful form of junk is made in the form of an inclined plane. The side elevation (for an adult) should have the following measurements: Length of base, 24 inches; height, 10 inches at one end, sloping down to 3½ inches. A convenient width for the junk is 16 inches. The inclined plane is hollowed out into a trough about half an inch in depth at its shallowest part, and adapted a little to the shape of the leg and thigh. The junk is firmly stuffed with horsehair and covered with ticking. It is admirably adapted for elevating and resting the limb in cases of fractured patella, synovitis of the knee, &c. The patient must be kept on his back, and, in this position, is unable to bend the knee. A single fold of bandage, passing over the thigh and secured on either side to the junk, is sufficient to fix the limb. The foot usually requires a little support. The apparatus is also well suited for elevating and resting the arm.

Stump junks are small pillows, stuffed with horsehair covered with ticking, and designed to support and raise the stump after amputation. If too much stuffed they are apt either to press injuriously on the stump or to allow the stump to slip off readily. Many surgeons employ splints for stumps immediately after amputation. When this is done, the junk can be fastened to the splint.

In using junks, of whatever shape, to raise and support an injured limb, care must be taken to give uniform support to the whole of the limb. For example, if the leg alone is raised on a junk, after an hour or two much discomfort will be felt from the strain thrown on the hamstrings. Injudicious arrangement of junks will greatly disturb the fragments in fracture.

C. T. Dent.

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KANGAROO TENDON LIGATURE is prepared from the tail of the kangaroo. When fresh, the tendons may be split up to any thickness required, and average about eighteen inches in length. They may be preserved dry for any length of time, or kept in some antiseptic solution. Before use, they should be soaked for at least twenty-four hours in carbolic solution. When soaked, they swell up to about twice the thickness they have when dry. Care should be taken that the tendons chosen for use show no longitudinal split, and that there are no nodosities in the course of the ligature. This ligature is best suited for tying arteries in their continuity. The writer has used them, with great advantage, for large atheromatous vessels in amputations, in cases of varix and varicocele, and for the ligature of the stump in castration. They would seem to be well suited for cases of oöphorectomy and the like. The knot should be tied without any jerk as firmly as may be desired, and the ends cut off short. The changes that follow in the ligature, consist in the splitting up of the tendon into longitudinal bands by an infiltration of small cells. These cells elongate, and subsequently form the walls of newly-developing capillaries, similar to those seen in granulation tissue. New blood-vessels also, forming in the coats of the artery, pass out into the interspaces of the tendon fibres. This is the process termed 'organisation of the ligature.' The tendon itself sets up no irritation whatever, if perfectly aseptic. It disappears very much more slowly than the catgut ligature; there is no need, therefore, to rupture the internal coat of the artery, though such rupture in all probability usually takes place. C. T. Dent.

KELOID. *See* Cicatrices, Pathological Conditions of.

KERATITIS. *See* Cornea, Inflammation of the.

KIDNEY, Injuries of the.—Injuries of the kidney are by no means uncommon, both in peace and war. They may be classed as 'non-penetrating' and 'penetrating.'

Non-penetrating Injuries of the Kidney.—*Symptoms and Diagnosis.*—These in civil life are most frequently produced by falls upon the back or side, by crushes, as in the case of 'buffer accidents' on the railways, or by carriage accidents in the streets, where the flank is struck by the shaft, or a wheel passes over the waist. Cases are also recorded, in which indirect violence has caused rupture of the organ. Thus, falls upon the buttock have been known to cause a tear of the kidney by the severe jarring induced. These and similar kinds of violence will produce, without any external wound, every degree of damage, from a slight bruise or tear in the cortex to complete pulping of the whole organ.

Symptoms (Objective).—A bruise or laceration of the kidney from non-penetrating violence to the side is recognised, in the first place, by the appearance of *blood* in the urine. This blood is, as a rule, thoroughly mixed with the voided urine, which varies in colour from slight 'smokiness' to bright red, and, unless poured out in great amount, does not form clots. When very abundant the latter are produced freely, and may even completely prevent the passage of the remaining blood and urine through the ureter or urethra. These symptoms, together with the history and the presence of bruising of the soft parts, will often be enough for a diagnosis. But there will occasionally be felt, besides, a *fulness in the flank* corresponding to the situation of the kidney. This may appear immediately after the injury, and, in such a case, will be due to the outpouring of blood from the wounded organ, either into the areolar tissue external to it, or under the capsule external to the surface of the kidney, or into the distended pelvis, the ureter being blocked by clot or bruise; in the latter case the hæmaturia will quickly cease. If the fulness make its appearance a little later, after the lapse of some hours, it is more likely to be urine effused in the same regions, though it may still, possibly, be blood. Bleeding from a moderate injury to the cortex soon ceases, as a rule, so that the amount of blood effused will probably not be sufficient to form a swelling in the loin, perceptible to the fingers. But if the peritoneal aspect of the organ be torn, there will usually be more or less blood poured out into the abdominal cavity, which will be perceptible or not by palpation and percussion in different positions of the body, according to its amount. If abundant, the dulness will be quite apparent, and the diagnosis will be aided by the weakness and pallor due to loss of blood. If the effused fluid in this case were *urine*, neither of these last two symptoms would be present, and the patient might continue to improve in strength and colour as the effusion increased, until possibly peritonitis set in with its usual symptoms. Besides these symptoms, wounds of the kidney have been observed to produce *retraction of the testicle* and *frequency of desire to micturate*, but this is not invariably the case.

The *subjective* phenomena usually noticed with injury to the kidney are, first, *shock*, although this is due more to the violence to the parts around than to the renal lesion. As is pointed out under Kidney, Surgery of the, there may be little or no shock observed in those cases where the injury is limited to the kidney alone. Next in order comes *pain*, that complained of being usually of a dull, aching character, increased to a sharp 'stitch,' perhaps, by deep inspiration or exertion of the abdominal muscles. But most characteristic of all is great *tenderness on palpation* in the situation of the kidney. This tenderness, taken in conjunction with the other symptoms enumerated, leaves no doubt as to the diagnosis. But in some cases a clot may form in the ureter and prevent the passage of blood into the bladder, the urine first drawn off having perhaps a trace of blood, but that subsequently voided being clear. Here, however, the patient will almost certainly show all the evidence of the condition known as renal colic, which in itself is very characteristic. *See* Renal Colic.

Diagnosis.—In forming a diagnosis in these cases, we are most concerned to know, in the first place, whether the blood seen in the urine comes really from the kidney, bladder, or urethra; and next, to what extent the kidney is damaged if it be the source. Blood derived from the bladder, unlike that coming from the kidney, is not *usually* thoroughly mixed with the urine (although sometimes perfectly so), and shows clots, or varies in the amount seen in the stream during micturition. At the end of the act there is usually some apparently pure blood passed, and often with much pain and straining, owing to the difficulty in forcing the clots through the urethra. If the bladder be ruptured, the blood may come away almost pure and unclotted, but the power of the bladder is gone. Blood derived from the urethra, on the other hand, is usually passed pure at the beginning of micturition, and is followed by clear urine producing little or no pain. *See* Hæmaturia.

Wounds of Pelvis.—That the pelvis of the kidney may be wounded by non-penetrating injuries independently of the kidney is proved by, at least, two cases; but the author, after careful search, is unable to find any others recorded in home or foreign literature. The first case was reported by Mr. C. Hawkins; the next occurred in the practice of Mr. Vincent, of St. Bartholomew's Hospital. In both, the pelvis was injured by the same kind of violence—viz. a cart-wheel crush—and both died about ten weeks later from spurious hydronephrosis or urinary abscess. By this is meant an effusion of urine into the post-peritoneal tissues, with the formation of a distinct sac limited by plastic inflammation. The *symptoms* were practically the same as those of ruptured ureter (vide *infra*). The nature of the case was not recognised during life; but after death, in both instances perforations of the anterior wall of the renal pelvis, leading into the newly-formed sac, were found.

Wounds of Ureter.—The only case known to the writer in which a positive diagnosis could be made, during life, of injury to the ureter alone from a non-penetrating injury, is that of a child lately under his care in University College Hospital. This patient, a boy of three years and eight months, was run over by a cab in August 1884, the wheel passing across just above the right iliac crest, and leaving extensive bruising of the parietes. At first nothing was to be made out but this bruising and some hardness of the side; then, some days later, a swelling with all the characters of hydronephrosis was felt on the right side. This was aspirated, and forty-five ounces of fluid were drawn off with all the characters of urine, but containing (as was to be expected of urine secreted under pressure), only a small percentage of urea, (0·5 per cent.); it also contained albumen. This aspiration was repeated on six occasions at intervals of about a week, with practically the same result. The *symptoms* upon which the diagnosis was based were—first, the nature and position of the injury, then the absence of severe shock, then the presence of two small worm-like clots in the urine first passed, not followed by any bleeding, and lastly the formation of a fluctuating tumour in the renal region, dull on percussion, of a distinctly rounded form, with the liver above and the colon in front of and internal to it; finally, by the result of the exploratory aspiration, which gave exit on each occasion to fluid with all the characters of urine and a definite amount of urea. This urea was present in very small amount so long as the sac was a closed one, but, as soon as a drain-tube was introduced and the fluid allowed to drain off without any obstruction, the percentage rose to 1·7 for many days. Here the writer proved the accuracy of his diagnosis by excising the kidney, which at once arrested the flow and relieved the child from all his distressing symptoms. In this case the urine was poured out into the areolar tissue behind the peritoneum, and there formed a large sac for itself, bounded by plastic inflammation. The wound of the ureter appears to have been not far below the pelvis of the kidney, the lower end of which was found, on excision, to be covered with granulations and phosphatic matter. The pelvis was healthy. The urine might, in another case, be poured out into the abdomen, being limited by lymph to a definite sac, or the torn end might be closed by clot or plastic material and the pelvis of the kidney be distended; or, finally, the last condition might be produced by simple bruising of the ureter, without destruction of its continuity. A case very like the above was recorded in 1843 by Stanley, but the patient recovered, and a positive diagnosis was impossible. These are the only instances known to the author of injury to the ureter alone.

Penetrating Injuries of the Kidney. But the kidney may also be injured by direct violence *penetrating* through the surface of the body, and many interesting cases of the kind are to be found, especially in the records of military surgery. Thus, it has been slit from top to bottom with one or other form of sharp instrument, as well as punctured by bayonets, lances, and swords. The wound in the flank has, in some cases, allowed the kidney to be forced out on the surface in the act of coughing. In many of these cases there was little or no constitutional disturbance, and the patient recovered quickly after replacement or removal of the protruded kidney. Again, the organ has been wounded by bullets either passing quite through it or lodging in its substance, recovery in each case being frequent. Any of these injuries may implicate either the proper renal tissue alone, the pelvis, or the ureter alone; and the symptoms, prognosis, and treatment will vary accordingly in each case.

The difficulties in the *diagnosis* and *prognosis* of penetrating wounds of the kidney are usually smaller than in the case of non-penetrating wounds of that organ. We have in the first place the *direction of the wound* and the nature of the weapon to guide us. For a simple uncomplicated wound of the healthy organ to take place, it can only be reached over a limited area in the loin just below the ribs, and then only in its lower portion. Except here, no penetrating wound can reach the kidney without producing a lesion of far more important parts, which will mask the renal mischief. Then the *amount of blood* effused immediately on receipt of the injury will aid the diagnosis; bleeding from the kidney being usually very free for a short time, but soon ceasing altogether. Renal blood in the urine, passed *per urethram*, is an almost constant symptom from the very first in all these cases; but this bleeding may be so free as to give rise to clots in the ureter or bladder, with all the intense suffering of renal colic or urethral dysuria respectively. *See* Renal Colic. *Retraction of the testicle* and *increased frequency of micturition* are often marked symptoms in these injuries. The *pain* in an uncomplicated case will be but an uncertain guide; but, on the other hand, we may be able to see the organ, which has often been partially or completely prolapsed through the wounds in the soft parts. As to *shock* after penetrating wounds, it may or may not be present, depending as it does rather on the effects of the wound upon the neighbouring structures than upon the kidney itself.

It may be conveniently noted here, that we are not to expect urine to flow from the first out at the lumbar wound, when the kidney has been damaged. As a rule this has not been observed for several days, or even in some recorded cases for weeks after the injury. In some cases again, urine does not appear at all in the external wound. But in those instances in which the latter does not heal kindly, urine usually makes its appearance at about the same time that suppuration becomes free in cases not completely aseptic — viz. about the fifth day or so. Having once commenced to escape from the lumbar wound, it may continue to flow for an indefinite time, amounting to months or years. But it may be stated generally, that penetrating wounds of the kidney through the loin have usually a great tendency to heal. Indeed, this is often one of the most serious points about them; for, if there be any suppuration, inflammatory swelling is apt to diminish or even completely arrest the flow of the urine down the ureter, and thus the only mode of escape for the products of inflammation and the secretion is through the wound. If, then, the latter close, there are, as a rule, the most severe constitutional disturbances — fever, anorexia, insomnia, &c.—lasting until either the wound has burst open again or has been re-opened by operation. This point ought never to be lost sight of, as it will materially influence the question of trying to make a permanent urinary fistula in the loin in preference to performing an early nephrectomy, which in many cases would be attended with less risk than usually follows tedious suppuration here.

Treatment of Injuries of the Kidney. This will depend upon whether the injuries are *penetrating* or *non-penetrating*, *recent* or *suppurating*. In the case of *penetrating* wounds, as they will probably be either incised, punctured, or bullet wounds, the earliest danger will be hæmorrhage. This may often be controlled by the application of firm pressure by the hand or bandage, with the addition of the ice-bag. Bleeding from the arm, until syncope has been produced, has also been resorted to with the best results in healthy plethoric individuals. Then, the hypodermic injection of ergot and free doses of gallic acid should be tried. If, however, one or more of the larger branches about the hilus is wounded, and neither pressure, cold, nor internal styptics are sufficient, there is little doubt that the proper course to pursue is, to enlarge the wound in the soft parts and seek for the bleeding vessel. If this be not easily found and secured, it is best to include the whole pedicle in one ligature and remove the kidney. *See* Nephrectomy. Cases intermediate between these two may be treated by plugging the wound with some antiseptic dressing, as iodoform or salicylic wool, with firm external bandaging and cold. The whole treatment, from beginning to end, should be conducted on the strictest antiseptic principles. In those instances in which the organ is prolapsed through the side as well as wounded, if seen at once it may be replaced after careful cleansing, and some such cases have recovered perfectly. But if it have been long prolapsed, strangulated, and rendered thoroughly foul, or otherwise seriously damaged, there ought to be no hesitation about its immediate removal after ligature of the pedicle.

In the case of *non-penetrating* injury to the kidney, the immediate treatment will be essentially the same as the above in the milder forms; but when severe, the surgeon is justified in waiting longer before resorting to operation on the organ, in view of the greater uncertainty in diagnosis. But here, too, where injury to the peritoneum and other organs seems improbable, and the patient is bleeding slowly to death through his ureter or into the perinephral tissues, if other means have failed the surgeon will be justified in cutting down and removing the torn kidney. In addition to the local treatment of the renal wound, another condition depending upon the hæmaturia will require careful attention, and that is the formation of clots in the bladder. This is often a source of much suffering and some danger; the clots may be too large to pass out by the urethra, and in their attempt to do so they act as a valve and completely prevent the escape of urine. The latter then goes on accumulating to an enormous extent, and causes most acute suffering. Any endeavour to relieve the bladder by an ordinary catheter fails in most cases, from clogging of the instrument at the outset. In the female, the urethra may be dilated in the usual way, and the clots extracted through a speculum. But in the male, washing out should be avoided, as the injected water will increase the distension and will not return. The use of Bigelow's large catheters and suction bottle will, probably, in the future supersede all other active treatment for the adult. The pelvis should be well raised while this is being used, so as to throw the clots well back from the neck of the bladder. By this suction-method the writer has lately succeeded in removing large clots, otherwise impossible to evacuate. If all means fail, we must only wait for the softening of the clots, and endeavour to relieve the suffering in the meantime by anodynes, with hot-air baths to diminish the flow of urine from the kidneys. The clots will usually break down in the course of a day or two, the relief being then speedy.

It should never be forgotten that bleeding from the kidney, with or without external wound, may be made to return, days or weeks after it has ceased, by over-excitement of the organ, such as the use of strong drinks or fluids which throw much work on its excretory functions.

The treatment of suppurating penetrating wound of the kidney will depend upon the extent of the injury in a great measure. If diagnosed to be moderate in degree its eventual closure, if kept aseptic and carefully drained, may still be hoped for, and this line of treatment should be tried. But as a rule the external wound tends to close long before the urine has returned to its normal route down the ureter, if it ever does this at all. This tendency to closure of the wound is most troublesome if the ureter be impervious, and often leaves the surgeon but little choice as to his line of action eventually. Increasing experience points to the conclusion that it would be well to perform nephrectomy early in such cases—that is, so soon as there appears to be no reasonable hope that the closure of the wound will be permanent. But in cases of extensive injury, where suppuration has commenced, nephrectomy should be undertaken very early if the patient's condition be otherwise satisfactory. Here we can hardly hope for proper repair of the organ, and the risks of prolonged suppuration, with decomposition of urine, in this region are very great.

The treatment of suppurating non-penetrating wounds, which are rarer, but which, when met with, indicate very grave lesions of the organ, probably associated with extravasation of blood and urine around, is a most difficult question to determine. In these cases, free antiseptic incision and drainage appear the proper means to take; but on incising, the organ should be carefully examined with the fingers, and if much injured it should be removed immediately. This will at once do away with the risks of bleeding and reduce the amount of decomposition, and will not add very materially to the shock. The treatment of bullet wounds of the kidney must be conducted upon the same principles which guide us in dealing with punctured wounds of the organ. But an element of danger is often met with here not present after ordinary penetrating wounds—namely, the presence of a foreign body. This is either the bullet, a fragment of a rib, or some material carried with the bullet in its course, such as a portion of clothing. Now, if this is left *in situ*, we may usually look forward to very prolonged suppuration. It is therefore better to anticipate this by extraction, if possible, of the foreign body, and in seeking for it we must not shun free incision either into the soft parts or the kidney itself if necessary. But, if the kidney have been much disorganised by the projectile, and extensive suppuration have been the result, it will probably subject the patient to less risk to remove the kidney early, than to leave the foreign body to be thrown off by disintegration, and the wound to granulate up. Cases, however, are on record where bullets have passed into or through the kidney, making a clean wound, which has healed up without any complication. Also, foreign bodies driven into the organ by a bullet have, in certain cases, after a time passed down the ureter and out *per urethram.*

The treatment of wounds or rupture of the pelvis or ureter will be the same in most cases—i.e. repeated aspiration from behind, until we have convinced ourselves of the nature of the tumour by an analysis of the fluid, especially its percentage of urea if any, and until we have satisfied ourselves as to the soundness of the opposite kidney by a careful daily examination of the urine passed from it. (See *Lancet*, January 17, 1885.) If the kidney on the damaged side show any signs of ceasing to secrete, we must wait; but if not, we may try antiseptic drainage from the loin. This, however, from the evidence of recorded cases, seems a very unsatisfactory proceeding where a healthy organ is being dealt with, on account, among other things, of the blocking of the drainage opening by phosphatic concretions and grave constitutional disturbance consequent thereon; and sooner or later it will be necessary to remove the kidney itself in most cases.

ARTHUR E. BARKER.

KIDNEY, Surgery of the.—The surgery of the kidney includes the consideration of two great groups of conditions—viz. injuries and diseases of the organ, which will be considered severally under special headings.

A great variety of *injuries* to the kidney has been described, but these have for the most part been associated with damage to other besides the renal structures, and the phenomena observed in connection with them have been complicated. When simple and uncomplicated, injuries to the kidney are not so serious as has usually been supposed, the chief dangers being, first, hæmorrhage; second, extravasation and suppuration, with all its attendant risks of septic infection and exhaustion. Shock has been purposely put last of all, for it is a mistake to suppose that wounds of the kidney alone are necessarily followed by much shock; this is not so. The organ has frequently been punctured, slit open, or otherwise wounded, without any notable effect upon the patient's nervous system; it has even been removed without an anæsthetic, and the operation has given rise to little or no suffering or general disturbance in the patient's system. It is rare, however, for injury to reach the kidney exclusively, and when the peritoneum, intestine, liver, spleen, or nerve-plexuses and vessels of the neighbourhood are involved in the same violence, then it is that the severe shock is seen so frequently, and erroneously attributed to the damage to the kidney.

Hæmorrhage also, though it is one of the great dangers after wounds of the renal tissues, is not necessarily severe, as is often supposed, even when the injury is extensive. It is only when some of the larger vessels towards the hilus of the organ are divided, that great bleeding is inevitable. This has been shown over and over again, as well by accident as when incisions have been made into the organ in the living subject; the bleeding, as the writer has seen in some of his own cases, and also in several in the practice of others, has been free for the moment, but has ceased very quickly either spontaneously or on a little pressure. It is otherwise, of course, when any of the larger renal vessels are torn, especially the veins; but even then, firm pressure and the application of cold, with ergot or gallic acid internally, will often arrest the bleeding. It is important to remember this tolerance of the renal tissues to injury; it will encourage us, on the one hand, to await patiently in certain cases the efforts of nature for the repair of injuries to the organs, and, on the other, it will stimulate us to undertake, in special instances, the local treatment of severe lesions more promptly and fearlessly than has yet been done.

As has been noted of bleeding, so it may be said of extravasation of urine, that in uncomplicated cases of moderate injury to the organ, this is not a certain or even frequent consequence. Slight bruises, lacerations, or incisions of the organ usually heal rapidly, without the pouring out of urine to any dangerous extent, and even in severe lesions this is not always a prominent factor. When either the pelvis or ureter is torn, urine may continue to be secreted into the post-peritoneal tissues without any immediate danger to life, the fluid being aseptic and of a non-irritating character when the organ is healthy. Effused into the peritoneum, it is usually followed by peritonitis, but not of an inevitably fatal form, as it may become limited by lymph and so form a sac, within which it is almost harmless.

Again, suppuration rarely follows simple and uncomplicated wounds of the kidney of moderate degree, and is only seen when a patient survives the severest lesions, and there is an abundant effusion of blood and urine around the organ. It is not necessarily a very dangerous complication, if promptly dealt with on antiseptic principles. It is more likely to follow upon lacerations or contusions of the renal substance than upon incised wounds, whereas the latter bleed more freely but are less liable to suppuration. The form of injury most likely to be followed by pus-formation is wound by a bullet, and, as a matter of fact, in most cases where such a lesion has not proved fatal at once, suppuration has been free and prolonged.

In *disease* the same tolerance of change is noticed in the kidneys. So long as one organ remains fairly healthy, the other may be extensively affected before it makes any serious difference to the economy. It may be the seat of new growth, a stone, pyonephrosis or hydronephrosis or a tubercular deposit, and yet the patient may go on for a considerable time without any serious evidence of constitutional derangement. Indeed it is remarkable how much both kidneys may be damaged without interfering with the general system, provided parts of the organ remain sound. From these considerations, as well as from the facts recently collected from the experience of operations upon the organ and its removal, we may gather that the kidney, though an organ of much importance, is not so easily embarrassed in its functions by mechanical disturbance or morbid alteration of structure as has been hitherto commonly supposed; and further, that the organ possesses a vast excess of secreting and eliminative power beyond what it is usually called upon to put forth, and, consequently, may be deprived of this margin temporarily or even permanently, without much apparent injury to the system, so long as a proportion of its secreting tissue is left, sufficient for the ordinary uses of the economy. Thus, it has been shown experimentally on animals, and more recently by operation on man, that one sound kidney is amply capable of doing all the work of the body when the other has been removed; just as it had often before been shown by pathological study that even a single kidney, though itself seriously damaged, might still continue to carry on fairly well the work of the system, perhaps for years, after its fellow had been completely destroyed by disease.

But it should not be forgotten, in these days of renal surgery, that there are certain diseases which are prone to develop in both kidneys at or about the same time, and that the operator is called upon to exercise the greatest caution in regard to them. This is notably the case with Nephrolithiasis, the condition which, perhaps more than any in this region, is likely to require surgical interference. At the root of this disease is a general constitutional vice of digestion and elimination, whose expression is the deposit of crystalline matter in the renal tissues for want of proper solution, or, possibly, as the result of a local catarrhal condition besides. What takes place on one side, then, is very likely to take place more or less on the opposite sooner or later. The same may be said perhaps of tubercular disease, and of the forms of suppurative Pyelitis. A knowledge of these facts will, on the one hand, incline us not to postpone operation too long when we have reason to believe that the disease is still unilateral, and on the other will deter us from any officious interference where it has lasted a long time.

No notice of the surgery of the kidney would be complete without a brief sketch of the modes in which the organ should be examined. Such an examination ought to be conducted with the utmost care, so that the surgeon may have in his possession every fact it is possible to collect, before he thinks of interfering with so important a region. After a careful inquiry into the patient's personal and family history, we should proceed to learn what we can of the state of the kidneys by a general physical examination of the body, but specially by (*a*) palpation and percussion of the renal region, and (*b*) by an examination of the condition of the urine. Palpation should be conducted as follows:—One hand should be placed crosswise beneath the last rib, as the patient lies on the back, with the knees drawn up and the abdominal muscles relaxed. Then, the other hand is placed anteriorly just below the cartilages of the ribs, and pressed backwards to meet its fellow. In this way the lower third of the organ can be felt between the two hands, the upper two thirds being, as a rule in health, above the last ribs and out of reach. If the organ be enlarged by morbid change, and indeed sometimes in health, it lies lower and more internally than this, and can be readily felt. The larger it becomes, the more it descends and the nearer it approaches the umbilical region, and in some cases it has been felt even a little beyond the middle line of the body. By this palpation the position, size, shape, and consistence of the kidney may usually be made out if the patient be under the influence of an anæsthetic, as ought always to be the case if an examination is to be thorough. By careful percussion, on the other hand, the relation of the abdominal contents to the kidney will be established. The colon will always be found in front of or to the inner side of renal swelling, no matter how large the latter may be. If it be emptied of gas, however, this may not appear at once, though the fingers may feel a ridge, formed by the empty colon, running down over the front of the tumour. But even then it may be brought out clearly by inflation with air or slow injection of water from the anus, the patient's pelvis being raised for the time, during the percussion and manual examination of the abdomen. Again, if the surgeon have a slender hand and the patient be an adult, much information may be obtained as to the state of the kidney by passing the hand up the rectum, the patient being under chloroform. This can, however, only be done in certain cases, and should not be forced.

Finally, much insight may be gained into the nature of renal swellings by needle-puncture through the loin. The kidney can always be reached with safety by introducing a needle just below the last rib, and about 7 or 8 centimètres ($2\frac{1}{4}$ to 3 inches) from the middle line of the back. If the needle be now thrust inwards directly across the axis of the body and towards the spine, it ought to strike the lower end of the healthy kidney. But, as this manœuvre is rarely necessary for the examination of the organ when of normal size, the point chosen should be lower down—viz. between the last rib and the crest of the ilium, and the direction of the needle should be somewhat forwards and a little downwards—in short, as nearly as possible towards the umbilicus. This is the direction the writer has been in the habit of adhering to as a routine practice. It is always best in such an examination to use a fine aspirator needle about four inches long, by which much information may be obtained as to the nature of the tumour, and warning be given at once should a vessel of any size be punctured. The dangers of this exploration are insignificant, the operation being post-peritoneal if performed with care; the writer is not aware of any injury having ever been produced by it, and he has both seen it used by others and employed it himself in a large number of cases. With very large renal tumours, considerable latitude may be given to the direction of the needle, so long as it is entered behind and kept away from the vessels entering the hilus. Catheterisation of the ureter is a manœuvre which in some cases, if feasible, may yield important results. It is only possible in the female, and then only in a very few cases. The difficulty of introducing the long slender instrument into the vesical orifice of the ureter after passage up the urethra is so great, and in very many cases insurmountable, that it is not likely ever to come into general use.

Examination of the urine will embrace an estimate of its total amount for the twenty-four hours, for a series of successive days (normal 40 to 50 oz.); its specific gravity (1,015 to 1,025) on the gross amount; its reaction (acid); and the percentage of urea (2 per cent. to $2\frac{1}{2}$ per cent. = 3 to $3\frac{1}{2}$ grs. to every pound weight of the body of the adult, somewhat more for children). Further, it will include tests for albumen and sugar, and a microscopical search for elements of tissue and crystalline deposits. Again, much valuable evidence may be obtained by a careful and extended observation of the temperature of the body in the morning and evening. There are conditions of the kidney in which this record will be of special value, taken, of course, with other symptoms. They will be referred to under the several diseases.

Nothing but the most careful examination in all these directions ought to satisfy the surgeon; and it is only by the greatest watchfulness and the fullest consideration of all the data obtained that grave errors are to be avoided, especially where operations are in contemplation.

Arthur E. Barker.

KIDNEY, Tumours of the.—These may be classified for convenience' sake into fluid and solid. Of the fluid tumours the most common are Hydronephrosis and Pyonephrosis, the less common the cystic kidney and hydatid swellings.

Cystic Kidney seems to be produced by similar causes to those originating hydronephrosis, but probably operating in a different way. It appears to arise, usually, from obstruction of one kind or another to the escape of urine from the kidney, but probably of an incomplete or intermittent character. In some cases, the mode of production is almost impossible to discover. But what is most frequently found is obstruction, either of the ureter or of one or more calyces or of some group of renal tubules, due to the presence of calculous matter or some catarrhal condition, or both combined. This may produce changes extending over every part of the organ, or may affect only a portion of it. The retention of urine, due to this obstruction, dilates the parts behind the latter until a number of loculi are produced, containing cloudy urine, or until the whole organ is converted into a cluster of sacs, varying from the size of a pea to that of an orange. With a moderate degree of cystic change a kidney will secrete freely and well; and, were the obstacle removed, would probably continue to yield urine of an average quantity and quality for an indefinite time. But, in extreme cases, so much interstitial change has taken place that secretion is most seriously interfered with, if not totally arrested. This has been learned from the operations, which of late years have become common for these conditions, leaving a fistula in the loin from which the urinary flow can be watched.

The symptoms of cystic kidney are in most cases very obscure, unless the condition give rise to a very distinct tumour, which is rare. We have to depend here upon local pain, usually of an intermittent character, often very severe, and upon traces of catarrhal products in the urine passed, and also upon the absence of evidence of other disease. But, in many cases, cystic kidney is found after death in persons who have never complained of any renal disorder. Fortunately for surgeons, the patients afflicted with this disease who seek their aid are usually suffering from renal calculus as an exciting cause, and have the characteristic pain and other evidence to guide them, and a definite evil to remove.

The *treatment* is the same as for renal calculus. In other words, if a stone is found on exploring the organ through a lumbar incision, it is to be removed; but if the source of obstruction is not found, and the suffering be severe and the cystic change far advanced, the organ should be removed, provided there is evidence that the opposite kidney is sound. It would be better probably to do this as a secondary operation in all cases, and only after patient trial of drainage through the loin; for in some cases the latter has been found to relieve and even cure the pain, and, on the other hand, the question as to the state of the opposite kidney is always a most difficult one to decide. *See* Nephrolithiasis.

Hydatid Cysts of the kidney are very rare, and need only be alluded to here so far as to say that the symptoms will be those of a fluid tumour of the kidney (*see* Hydronephrosis), together with the extra evidence to be obtained by aspiration of the tumour in the loin, and examination of the fluid removed for hooklets, &c. The urine passed *per urethram* will also in some cases contain the latter.

The *treatment* for hydatid disease of one kidney alone would be free incision through the loin into the sac, and removal of its contents and cyst wall, with free drainage of the resulting cavity.

Among the primary *solid tumours* of the kidney are nearly all the neoplasms—if we include under this term syphilitic and tubercular deposits, as is often done. Thus we find sarcomata, carcinomata, lipomata, angiomata, rhabdomyomata or tumours containing striped muscle-fibres, also some curious heterotopic growths formerly supposed to be lipomata, but now recognised as derived from fragments of the supra-renal capsule included in the kidney-substance during its development, which have taken on new growth at a later period of life. In the pelvis of the organ we also find papilloma, and, in any part, syphilitic gumma and tubercular deposit. These new growths are met with at all ages from infancy upwards, and apparently with equal frequency in both sexes. It is a point of some interest to note that, with the exception of the papillomata, syphilomata, and tubercular deposits, all the new growths appear to originate in the cortex and to spread inwards towards the pelvis. The sarcomata are mostly of the small-celled, soft, and vascular variety, and bleed readily; the carcinomata are also very soft, and cause hæmaturia in many cases; the same may be said of the papillomatous and tubercular masses. All the others as a rule do not bleed. It should be remembered here, as an important point bearing upon the question of operations on the kidney, that the new growths of the organ appear to limit themselves for a long time to it alone, and do not readily infect either surrounding tissues or the adjacent glands or circulation. They sometimes attain enormous size without any sign of generalisation anywhere.

The *diagnosis* of these tumours is based upon the same general considerations which guide us in their diagnosis elsewhere. We have, indeed, few special indications to help us except the state of the urine. Here, in the case of the sarcomata, carcinomata, and papillomata, we may find blood and, as in one of the writer's cases, shreds of the tumour; and, in the case of the tubercular kidney, there may also be hæmaturia, and, besides, a purulent sediment with shreds of caseous matter. But of the presence of the other growths no special signs are known. In all cases the history, both personal and family, must be carefully made out; then the duration and nature of the symptoms; then the urine be carefully examined, both before and after palpation of the tumour; finally, much information may be gained by careful puncture of the mass from behind, at the point of election, with an aspirator needle, and examination of the material withdrawn.

As to the *treatment* of these new growths, further study is required before definite rules can be laid down. But enough has already been learned to point to the conclusion that, with a clear history of malignant tumour, an exploratory incision should be made as early as possible, and if a growth be found, that it should be removed by NEPHRECTOMY. Many cases are on record in which this has been done successfully, and many more in which the want of success has been due to delay of the operation until matters had gone too far. For the benign tumours little treatment is ever called for; they often give no sign of their presence during life. ARTHUR E. BARKER.

KNEE, Diagnosis of Affections of the. *See* THIGH AND LEG, Diagnosis of Affections of the.

KNEE, Dislocations of the.—Although the bony surfaces of the knee-joint offer little impediment to dislocation, the ligaments holding together the bones are so strong that complete dislocation is very uncommon, except as the result of disease, and partial displacements are far from frequent.

Dislocation may take place *outwards*, *inwards*, *forwards*, *backwards*, and by *rotation outwards*. The lateral dislocations are incomplete; the forward and backward may be either complete or incomplete.

Partial dislocation outwards of the tibia is the most frequent accident, and may be caused by a weight striking the outer condyle when the limb is extended, or by an outward fall when the leg is caught in a hole. The outer condyle rests on the inner articular facet of the tibia, the inner condyle projects internally, and the outer tuberosity of the tibia and head of the fibula form a prominence on the outer side of the joint. A certain amount of rotation outwards of the leg usually accompanies this injury. *Reduction* is easily effected either by flexion or extension, combined with pressure, and an ice-bag or Leiter's coil should be applied to allay inflammation, after which the joint should be kept on a splint for a month to allow time for the reunion of the ligaments. After this, a knee-support should be worn for some months. There is a rare accident with which this dislocation may be confounded, viz.: oblique fracture of the outer tuberosity of the tibia with fracture of the fibula, caused by a jump from a height on to the feet.

Partial dislocation inwards is usually caused by a fall on the outer side of the leg, the limb being bent under the body. The inner tuberosity of the tibia forms a prominent tumour immediately beneath the skin on the inner side, whilst the external condyle of the femur projects externally. The internal saphenous vein is liable to be injured by the displaced tibia. *Reduction* is easily effected by pressing the tibia outwards, at the same time that the foot is drawn inwards.

Dislocation forwards gives rise to very great deformity, and, when complete, the tibia may be forced up on the femur to the extent of two to four inches. It may be caused by some force striking the front of the femur when the leg is fixed, or by a heavy weight falling from the shoulders and striking the calf of the leg, whilst the person is stooping. The tibia forms a distinct prominence anteriorly, whilst the condyles of the femur project into the popliteal space, stopping pulsation in the artery and giving rise to great pain by pressure on the nerves. The dislocation is usually easily *reduced* by extension, after which it is necessary to keep the knee at rest for a month or six weeks. Passive motion should then be employed, and the knee be supported for some months in a leather cap.

Dislocation backwards is about half as frequent as dislocation forwards. The tibia projects into the popliteal space, compressing the vessels and nerves, and the condyles of the femur ride forward. The limb is usually found in a state of over-extension, and the patella lies with its surfaces horizontal beneath the projecting femur. *Reduction* can be effected by the surgeon fixing the foot with his knee in front of the ankle, and then clasping his hands behind the displaced head of the tibia, and drawing it downwards and forwards into a state of flexion. Should this method fail, ordinary extension may be tried. The after-treatment will be same as in the other forms.

Dislocation by rotation outwards is very rare. The tuberosities of the tibia are directed antero-posteriorly, and the patella projects on the outer side, whilst the inner surface of the leg is directed forwards and the fibula backwards. *Reduction* is to be effected by first making extension, and then twisting the leg inwards.

Congenital Dislocations are usually forwards.

Compound Dislocations as a rule necessitate amputation of the limb.

R. Clement Lucas.

KNEE, Excision of the. *See* Joints, Excision of.

KNEE-JOINT, Amputations at the. Disarticulation at, or amputation through the knee-joint, although alluded to and performed by the older surgeons, including Hildanus, Hoin of Dijon, J. L. Petit, Blandin, and Brasdor, did not find general acceptance until Velpeau, in 1829, strongly advocated the procedure, which he carried out by a circular amputation four fingers' breadth below the patella. Even then, it had but a short-lived popularity until Malgaigne expressed his emphatic opinion that it had been too soon abandoned, having regard to its special advantages in facilitating the movements of the hip-joint. His advocacy was supported subsequently in America by Smith, Markoe, and Brinton, and in England by Holmes, Pollock, and others. The advantages mentioned by Markoe are —(1) the slight shock attending the operation; (2) the limited section of the tissues; (3) the non-exposure of the muscular interspaces and the consequently diminished risk of suppuration in the thigh; (4) the comparatively few vessels requiring ligature; (5) the attachments of the thigh muscles being mainly preserved; (6) the absence of muscular retraction; (7) the diminished risk of osteo-myelitis and exfoliation, from the femur not being sawn across; and (8) finally, the useful character of the resulting stump. In spite of these advantages, the operation, owing to the irregular surface of bone on the face of the stump, the alleged liability to exfoliation of the cartilage of incrustation, and the high mortality, fell again into disfavour.

The next procedure adopted was the operation, recommended by Syme, through the condyles of the femur, but with a short anterior and long posterior flap taken from the calf of the leg, almost similar to the flaps made by Hoin in amputation through the knee-joint. The long posterior flap is, however, an obvious disadvantage. Hence Carden introduced a modification, dispensing with the posterior flap and substituting a long anterior skin flap. Carden's modification, which possesses many advantages, is still frequently performed. 'The operator, standing on the right side of the limb, seizes it between his left forefinger and thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round, through skin and fat, below the patella, to the spot pressed by his thumb; then, turning the edge downwards, at a right angle with the line of the limb, he passes it through the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards and the saw applied.' This operation, however, has two defects—(1) the danger of sloughing of the anterior flap, and (2) of a large gaping wound, owing to the tendency to retraction of the posterior tissues. These defects are to a great extent remedied by Gritti's operation, which consists in a somewhat square-shaped or rectangular flap taken from the front of the knee, retaining the patella, the femur being divided on a level with the condyles. In addition, the cartilaginous surface of the patella is removed, and the patella and the cut surface of the femur are placed in apposition, in the hope of bony union taking place. This operation suggests Pirogoff's amputation transferred to the knee-joint.

But in Gritti's operation there is a difficulty to be overcome—that of keeping the patella and the cut surface of the femur together. With this object, the writer has suggested a higher femoral section—namely, at a point from half to three-quarters of an inch *above* the antero-superior edge of the cartilage of incrustation. This point is selected, as a femoral section lower down inevitably leads to the tilting forward of the patella during the healing of the wound; and, on the other hand, were the section made higher than the point indicated, the medullary canal would be opened with increased danger to the patient; besides, the risk of the split patella hanging down at a lower level than the cut surface of the femur would be present. The femoral section being well above the condyles of the femur, the writer has suggested that this modification of Gritti's amputation be designated 'supra-condyloid.' Its steps may be briefly described:—The anterior flap, not rectangular, but oval, should reach from a point one inch above either condyle to the other, and thence downwards below the tubercle of the tibia. A posterior flap, at least one-third the length of the anterior flap, should also be formed, since the posterior tissues retract so much more than the anterior. Unless the flap be made in the situation indicated, there is the risk of a gaping wound, as in Carden's and Gritti's operations. By suturing the two bones together and leaving the sutures in the wound, displacement of the bones is effectually prevented, and the chances of bony union largely increased, while the condition most favourable to fibrous union exists.

The special advantages of the supracondyloid amputation are:—(1) The posterior surface of the anterior flap is furnished with a natural synovial lining, which largely diminishes the risk of exhaustive suppuration and purulent absorption. (2) By suturing the bones together, as described, the possibility of the split patella shifting from its place on the cut surface of the femur is prevented. (3) The osseous curtain, formed by the split patella covering the surface of the femur, lessens the risk of pyæmia and sloughing, as in the case of the periosteal curtain recommended by Von Langenbeck. (4) The vessels are divided at right angles to their continuity, instead of obliquely, as in other flap operations. (5) The posterior flap lessens the risk of a gaping wound posteriorly. (6) The diminished liability to tubular sequestra. (7) Only one large artery requires ligature. (8) There is less of shock than in the higher amputations, the divided muscles being few, and cut, not through their fleshy bellies, but at their tendinous extremities. (9) There is less liability to suppuration. (10) The medullary membrane not being interfered with, there is less liability to osteo-myelitis. (11) The preservation of the normal attachments of the extensors of the leg.

In suturing the bone, wire or chromicised catgut should be used. Having had in his earlier experience to deal at times with serious hæmorrhage from the popliteal vein, the writer now ligatures that vessel with chromicised or carbolised catgut, and no such trouble has since ensued. The cases for which this method of amputation is most suitable are—(1) Fractures of the leg necessitating amputation, in which the injury to the soft parts extends high up; (2) extensive necrosis, or abscess of the head or upper third of the tibia; and (3) cases of malignant growth, in which the removal of the whole leg is expedient.

William Stokes.

KNEE-JOINT, Diseases of the.—The knee-joint, from its prominent position, mobility, and active function, is peculiarly prone to disease.

Acute synovitis is very common in the knee, and is usually of *traumatic* origin. The swelling of this joint is obvious;

it reveals the outline of the synovial reflexions, making a rounded prominence over the lower end of the front of the femur, and bulging on either side of the patella. Fluctuation is easily felt from side to side, and the bulging is increased by pressing back the patella, which is thrust forward by the fluid, and can be made to 'rap' against the femur. The increased temperature of the joint can also be easily felt by the hand. Movement will be resisted and the joint fixed in the slightly flexed position, by the rigidity of the surrounding muscles.

If the synovitis be of *rheumatic* origin, other joints will probably be affected, and there will be, in addition, the general symptoms of rheumatism. It often happens however, that inflammation persists in one joint after the subsidence of the fever and the recovery of the other articulations, and the knee is especially liable to be the joint selected. Synovial effusion persists or recurs, and, when the swelling is removed, the joint is left stiff by adhesions both within and around the joint.

Pyæmic synovitis frequently attacks the knee, and in the acute form usually leads to rapid and destructive suppuration. The occurrence of suppuration is indicated by increase of the constitutional disturbance, and by the presence of œdema along the sides of the condyles of the femur and the head of the tibia.

The first essential in the *treatment* of all acute inflammations of the knee is to ensure perfect immobility of the joint. A splint must be applied, extending to the upper part of the thigh and including the whole of the leg and foot; and to this the limb is to be bandaged in a position of slight flexion. A McIntyre's splint is a convenient form, but whatever kind of splint is used must have a foot-piece, and include the whole limb as far as the upper fourth of the thigh. In many cases much comfort is given by swinging the limb, as in a 'Salter's cradle.' In the early stage of synovitis the joint may be leeched, or cold applied; and when the acute symptoms have subsided, blisters and pressure are useful.

When suppuration is suspected, the nature of the effused fluid is to be ascertained by aspiration, and, if pus is present, the joint must be freely laid open by an incision on each side of the patella, as far back as possible, so as to thoroughly drain the cavity.

Subacute synovitis, leading to hydrops articuli, is more commonly seen in the knee than in any other joint. The joint is weak, and bulges in all directions from the contained fluid. If blistering or pressure by an elastic bandage or strapping does not remove the fluid, the joint must be emptied by aspiration, and pressure be afterwards maintained; and if it again fill, an injection may be used, such as a 1 per cent. solution of carbolic acid, or a mixture of tincture of iodine and water, 1 to 10 or 20. An elastic knee-cap must be worn afterwards. *See* HYDRARTHROSIS.

Recurrent synovitis in the knee is sometimes due to adhesions within the joint, in which case movement will be restricted, and perhaps painful, in certain directions. The adhesions are to be ruptured by sudden flexion during anæsthesia.

Chronic synovitis of the knee-joint is commonly met with in the form of pulpy degeneration, giving rise to an indolent elastic swelling of the synovial tissue, and leading eventually to ulceration of the cartilages and softening of the ligaments. After a time, displacement of the bones occurs, the tibia being drawn backwards and rotated outwards and the limb flexed, so that the articular surface of the femur projects in the front of the joint, and the patella rests on the outer condyle.

Scrofulous disease of the knee may commence thus, or, as is more commonly the case, in a chronic articular ostitis. In either case, the disease makes very indolent and slow progress, the products of inflammation showing an early tendency to degenerative changes, so that the synovial membrane, having first become thickened and pulpy, slowly caseates or suppurates; or the expanded joint-ends of the femur and tibia gradually undergo central softening, and ulcerate either in the direction of the surface or into the joint. These changes are accompanied by but little pain or pyrexia.

At the commencement of chronic disease of the knee-joint, the limb must be at once fixed upon a splint; if there be any considerable heat or pain about the joint, perfect rest must be enjoined, but if these be slight, a well-fitted leather splint, or a Thomas's splint, may be applied, and the patient allowed to get about on crutches and with a thick sole to the boot on the sound limb. Every possible attention must be paid to the general health and to improving the reparative power; while, at the same time, local counter-irritation may be effected by the cautery or repeated small blisters, and followed by strapping over mercurial ointment.

In more advanced cases of synovial degeneration, in young subjects, the pulpy tissue may be scraped or dissolved away through lateral incisions made on each side of the patella. A Volkmann's spoon should be used for scraping out the diseased membrane; sulphuric acid diluted with two parts of water may be used for its solution. The remaining alternatives are excision or amputation.

If the disease commence in a chronic ostitis of the end of the femur or head of the tibia, symptoms of suppuration must be carefully watched for, and any indication of the presence of matter within the cancellous tissue must be followed by perforation of the bone, to endeavour to obtain its exit upon the surface rather than into the joint. It is not uncommon in performing excision of the knee to find, on making the section of the tibia, the cavity of an abscess from which matter has made its way into the joint. If such a cavity does not extend far from the joint surface, it may be scraped out, and a satisfactory ankylosis may still be obtained; but if the bone be extensively softened or carious, amputation will be necessary. The same may be said of abscess in the end of the femur.

Syphilitic disease of the knee is met with, both as a synovial effusion accompanying the secondary stage, and also as a gummatous infiltration of the synovial membrane, or of the sub-periosteal or other tissues around the joint.

The joint must be kept at rest during the administration of antisyphilitic remedies, and under these the secondary synovitis usually subsides. The tertiary disease often leaves much stiffness from thickening and cicatricial contraction, both within and without the joint. This form of disease is also met with in inherited syphilis. In addition to the constitutional treatment, shampooing, passive movements, and friction with oleaginous liniments must be resorted to.

The knee is one of the joints most frequently the seat of *osteoarthritis*, the symptoms of which are usually easily recognisable. There is a moderate amount of synovial effusion, marked and often loud crepitation on movement, and alterations in the shape of the ends of the bones, obvious both to sight and touch. Much lameness results, and sometimes much wasting of the muscles of the thigh and leg. The disease may be retarded and ameliorated, in its earlier stages, by treatment directed to the correction of rheumatic tendencies, and by the local use of warm douches and frictions; the joint should be supported, as by a flannel bandage, but not fixed; and unless there be much or increasing swelling, moderate use of the limb may be permitted.

Loose cartilages, though occasionally met with in other joints, are found chiefly in the knee, wherein their presence is the more obvious because of the grave inconvenience to which they give rise. The anatomical structure of the joint and its free movement make it especially easy for the loose body to slip between the ends of the bones; this gives rise to acute pain, and may cause the patient to fall. Recurrent synovitis is set up, with increasing weakness of the joint, and the usefulness of the limb is materially impaired. The body can be pushed to the surface of the joint and felt through its coverings. Sometimes it is pedunculated, and its movements therefore restricted to one part of the joint. Loose bodies are often multiple.

If the patient be in good health the loose cartilage is best removed by direct incision of the joint, with antiseptic precautions. If this be not desirable, attempts should be made by strapping and bandaging to fix the loose body in one part of the synovial sac, and an elastic knee-cap be worn to restrict movement and support the joint. *See* Loose Cartilages.

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KNOCK-KNEE. *See* Genu Valgum.

KOCHER'S OPERATION. *See* Tongue, Operations for Removal of the.

KYPHOSIS. *See* Antero-Posterior Spinal Curvature.

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LABIA PUDENDI. *See* Vulva.

LABYRINTH, Affections of the. *See* Ear, Internal, Diseases of the.

LACRYMAL APPARATUS, Diseases of the.—Acute Inflammation of the Lacrymal Gland, or of the connective tissue immediately surrounding it, is acknowledged by all observers to be of rare occurrence. The local signs are redness, heat, pain, swelling, and disturbance of function. In some cases, the secretion is greatly increased in quantity; Schmidt, for example, stating that he collected by means of a sponge, in the course of twenty-four hours, no less than two pounds seven and a half ounces of fluid. In other instances it is diminished. The globe of the eye is pushed downwards, or downwards and inwards, and its movements are interfered with, so that diplopia results. Vision is not, however, materially lowered, because the elasticity of the optic nerve permits some stretching to take place without impairment of function. Intolerance of light and spasm of the lids have been occasionally noticed.

The process of suppuration in the lacrymal gland is attended with considerable disturbance of the general health. The swelling remains for some time hard and resistant to pressure, owing to the dense tissues surrounding it. It is limited to the outer part of the orbit and eyelid, and in the course of ten days or a fortnight begins to soften, and may point either in the conjunctival sac or on the skin near the margin of the orbit. The pre-auricular lymphatic gland is sometimes swollen. The treatment consists in the application of leeches, irrigation with cold water, purgation, and general antiphlogistic measures. Owing to the deep situation occupied by the gland, the abscess, if allowed to burst spontaneously, is apt to leave a fistulous tract behind it. It should therefore be opened freely as soon as fluctuation is perceived. The incision should be made parallel with the margin of the orbit and the fibres of the orbicularis muscle. A drainage-tube may be introduced.

Chronic Inflammation of the Lacrymal Gland is also of rare occurrence. The symptoms resemble those of the acute form, but are more subdued. The formation of a fistula is not infrequent. Where this unfortunate event has taken place, attempts may be made to effect its cure. The most effective method consists in threading two needles with a piece of fine silk. One of the needles is then introduced through the external orifice, and made to travel for some distance up the fistulous passage before perforating the conjunctiva; the other needle is carried through the conjunctiva close to the cutaneous orifice of the fistula. On tying the two ends of the silk together, a portion of the conjunctiva is enclosed in the loop, which on cutting its way out establishes a new opening for the tears. After the edges of the fistula have been freshened, and brought together with a suture or two, the cutaneous passage closes. Another method consists in heating to redness, by means of a galvanic battery, a wire, which has been introduced into the fistula.

Chronic Enlargement of the Lacrymal Gland may be due either to simple hypertrophy of the gland-tissue, or to the formation of such benign tumours as adenoma, fibroma, myxoma, and chondroma; or lastly to the gland becoming the seat of the malignant and recurrent tumours known as round-celled and spindle-celled sarcoma, which usually occur in children, carcinoma and epithelioma, which are most common in old persons. In several of these forms of disease cysts and partial colloid degeneration may supervene. Cases of syphilitic disease of the lacrymal gland have been recorded by several observers; one by Mr. Streatfeild was cured by the use of mercury and iodide of potassium. It is very difficult to diagnose a chronic enlargement of the lacrymal gland from a node, and it is probable that the two affections have sometimes been mistaken for each other, especially as both may proceed from the same cause, and may both disappear under the same treatment.

Extirpation of the Lacrymal Gland. The lacrymal gland consists of two parts, one superior, the other inferior and in close relation with the conjunctiva. If the upper or larger mass alone require removal, it is sufficient, in prominent eyes, to make a cut through the skin just below the eyebrow, parallel to the margin of the orbit, and, in deep-set and low-browed eyes, to shave the hairs and divide the skin along the middle of the eyebrow for the space of an inch and a half. The depth at which the gland is situated is considerable, and the dissection must be continued till it can be seized with vulsellum forceps and drawn down. A little manipulation with the handle of the scalpel will then effect its removal. When the gland is greatly augmented in size, or when both parts have to be removed, the palpebral fissure may be enlarged by a cut made towards the temple from the external canthus. The small branches of the facial artery which are divided should be tied, and the upper lid can then be dissected up till the gland is exposed, when it may be seized and removed as before. Mr. Z. Laurence, who extirpated the gland on several occasions, not only enlarged the palpebral fissure in the manner just described, but made a cut below the eyebrow, which was continued till it met the first incision at an acute angle. The triangular flap thus made was dissected back towards the nose, till the gland was exposed.

Obstruction of the Canaliculi.—The orifice of one or other of these minute tubes is sometimes occluded by a delicate pellicle, which may be broken down with facility by the pressure against it of a sharp-pointed probe or a breast-pin. It appears to be a congenital defect when the opening is obstructed in this or any other manner. The tears collect at the inner corner of the eye, and, if not wiped away, from time to time trickle over the margin of the lid and down the cheek, which they redden and excoriate. This condition, which is named *Epiphora*, is especially marked on exposure of the eye to cold winds, bright lights, and after food, and during any mental excitement occasioning congestion of the vessels. In such cases there is usually some redness of the conjunctiva, both ocular and palpebral. A little puriform mucus appears in the conjunctival sac, and the lids stick together during sleep. When these symptoms have suddenly appeared, a careful inspection should be made of the puncta lacrymalia with a hand lens. An eyelash or other foreign body may sometimes be discovered, the removal of which at once relieves the symptoms. Small dacryoliths, and occasionally accumulations of leptothrix, have been observed to occlude the canaliculi. As a rule, they require removal by an incision. Occlusion of the canaliculi is often the result of burns, lacerations, and surgical operations performed upon the lids, as well as of the development of polypi. In the former cases, efforts should be made to restore the patency of the canal, which may sometimes with care be effected.

Deviation of the Puncta.—It is of great importance that the puncta should occupy their normal position. If the margins of the eyelids are turned inwards, they become applied to the globe of the eye; if outwards the fluid cannot enter these orifices, and in either case epiphora results. The conditions leading to deviation of the puncta are very various. In old people eversion of the lower lid is often attributable to mere relaxation of the skin and loss of power of the orbicularis muscle. It may also be due to paralysis of the facial nerve, a condition that has been observed in infants as the result of the employment of forceps in delivery. Such cases are commonly incurable, and removal of the lacrymal gland holds out the best prospect of improvement. Thickening attended with some eversion of the lids is a frequent result of ciliary blepharitis; and when this is ascertained to be the cause, the conditions which have led to the inflammation of the lids should be carefully studied, attention should be paid to the refraction of the eye, and appropriate local and general measures be adopted, before resorting to any of the operative measures which are about to be described. See *Blepharitis Ciliaris* under Eyelids, Diseases of the.

Mucocele or Chronic Dacryocystitis. This condition is usually but not necessarily associated with epiphora—that is to say, where mucocele exists there is almost always epiphora, but epiphora may exist without mucocele. It is probably, in most instances, the result of antecedent inflammation of the sac.

The symptoms are those of a smooth, rounded, or oval tumour presenting itself at the inner angle of the eyelids in the position of the lacrymal sac. It is often bilobed in consequence of the position of the ligamentum palpebrale internum, which crosses the sac at right angles, and binds it down near its centre. It is painless and tense, though possessing a considerable amount of elasticity. In some instances no impression can be made upon it by pressure, whilst in others it may be partially or completely emptied, the contents either altogether passing down the nose, or being regurgitated through the canaliculi and puncta into the sac of the conjunctiva. Not infrequently it flows in both directions. The fluid which regurgitates is at first clear, thin, and transparent, as though composed of tears alone, but almost immediately becomes thick and glairy, and if the pressure be continued puriform mucus is usually discharged. The flaccid sac can then be felt. In most instances the conjunctiva, especially near the inner angle of the eye, is red and inflamed, and not infrequently pustules appear on the margins of the lids; whilst, in a large proportion of cases, the epithelium of the cornea at the sclero-corneal junction may be detached, a condition which may develop into an ulcer of considerable depth with whitish slimy base. According to Panas, in the healthy state the membrane of the sac secretes a glairy fluid, in which columnar epithelial cells destitute of cilia may be seen with the aid of the microscope. In disease, lactescent striæ appear in the fluid, which at first sight look like pus, but which are only accumulations of mucus-globules, resembling those met with in the fluid secreted from other inflamed mucous membranes. It is only when the inflammation has attained a certain degree of intensity and has become the seat of an epithelial exfoliation or ulceration, that the contents of the sac become really purulent. In some instances, small plates of cholesterine are to be found in the fluid. In the early stages of chronic inflammation of the lacrymal sac, the membrane is either uniformly reddened or presents patches of congestion. After some time it becomes thickened and soft, bleeding freely when touched; and it is stated by those who have laid the sac open—an operation now rarely performed—that the mucous membrane presents a villous aspect, with rugæ that must greatly tend to occlude the passage.

At certain points constrictions are apt to occur, the most common site being the point where the lacrymal sac becomes continuous with the nasal duct, the next the point of entrance of the canaliculi into the lacrymal sac, and perhaps the next the inferior orifice of the nasal duct. In the dissection of a lacrymal fistula which had existed twenty-two years without treatment, A. Voisin found that the common opening of the two lacrymal ducts into the lacrymal sac was obliterated; the sac when empty and retracted presented friable walls. There was a complete obstruction at the point of junction of the sac with the nasal duct. In some instances, the lacrymo-nasal passage has been observed to be constricted at the point where the sac is continuous with the nasal duct; in others the mucous membrane of the sac has been found to be of a vivid red colour, with considerable thickening of its walls; in others the sac has been found to be filled with a polypoid growth.

In regard to the etiology of chronic dacryocystitis, it is generally acknowledged to be associated with signs of strumous diathesis. The patients are often soft and flabby, with dull turbid complexions, and are subject to chronic inflammation of the eyelids and of the mucous membrane of the nose. In such cases the course of the disease is easy to read. The inflammatory process, affecting the Schneiderian membrane or the conjunctiva, spreads by contiguity up or down the naso-lacrymal passage. The secretion of mucus is augmented and, gravitating towards the bottom of the nasal duct, the orifice of which may be congenitally small and is now still further reduced by the general swelling of the mucous membrane, plugs and occludes it, or at all events renders the passage of tears very difficult and slow. The conditions now react on each other. The mucus and tears accumulating, still further distend the sac and increase the congestion, and the state of the whole sac and its contents is ripe for an explosion of acute inflammation, which may readily be excited by a slight blow, by the entrance of some septic matter, by cold or, possibly, even by disease of the adjoining bones caused by the long-continued pressure. Badal is of opinion that errors of refraction play an important part in the production of disease of the lacrymal organs. The error is as a rule moderate, and is on the side of hypermetropia.

In some instances of mucocele, however, a totally different condition of disease is present, and we have to deal, not with a constriction of the lacrymo-nasal passage, but with the growth of a cyst in the lacrymal sac. In such cases, the tumour may for a time only partially occlude the duct, and digital pressure over the sac may cause some fluid to regurgitate into the conjunctival sac and some to descend into the nose; but, after emptying it as thoroughly as possible in this way, there still remains a swelling which cannot be dispersed by pressure, and at a later period, when the cyst has grown sufficiently to fully occupy the sac and to distend its walls, no fluid will escape even when the pressure is very firmly applied.

If left to itself, chronic inflammation of the lacrymal sac has a strong tendency to induce caries and necrosis of the bones surrounding it. In some instances there are outgrowths from the bone itself, which may be painful or indolent; in others there is thickening of the periosteum, resulting from specific periostitis; in others, again, some portion of the lacrymal bone or ascending process of the superior maxillary is carious or necrosed. The writer has seen one case in which the frontal sinuses were filled with thick muco-purulent fluid, and in which there was caries of the ascending process of the superior maxillary bone and perforation of the palate-bone. A cure was effected by slitting up the canaliculus and passing the large end of Weber's probe, making a deep incision in the palate and removing some sequestra, and the sedulous use of antiseptic injections. There was no history of syphilis in this case, nor the slightest suspicion of such disease having existed. Many cases have been reported, however, in which the caries and necrosis of the facial bones have followed syphilis, and its pre-existence would certainly modify the treatment to some extent.

Treatment.—The different methods suggested may with advantage be considered under the following heads:—1. The prevention of the flow of tears. 2. The obliteration of the lacrymo-nasal passages. 3. The restoration of the patency of the lacrymal passages; and, lastly, 4. The formation of new passages for the discharge of the tears.

1. The prevention of the secretion of tears can only be accomplished by tying the ducts of the lacrymal gland, as recommended by Sedillot, or by the removal of the lacrymal gland, an operation that has been recommended and practised by P. Bernard, Z. Laurence, and Tavignot. The method of performing it has already been described.

2. The proceedings for the obliteration of the lacrymal passages include the obliteration of the puncta, the excision of the lacrymal sac, the laying open and cauterisation of the sac.

3. The methods for restoring the patency of the lacrymal passages consist in the employment of injections, and the gradual or rapid dilatation of the ducts, with or without antecedent slitting up of one canaliculus.

4. The operations for making a new passage consist in perforating the os unguis with the object of allowing the tears to drain into the nose, or in establishing a communication with the maxillary sinus.

It may be laid down as a general rule in the treatment of chronic dacryocystitis and mucocele, that the simpler measures should be exhausted before resorting to cutting instruments and the passage of probes. These, especially in unskilful hands, and sometimes even in the hands of those who have had considerable experience, do infinite harm. It is exceedingly difficult to make the finer probes pass down the lacrymal sac and nasal duct, even in the perfectly normal eye. They can readily be made to traverse the whole length of the canaliculi, but beyond this point they are apt to become entangled in the folds of the mucous membrane, and the slightest pressure makes blood appear—a sure proof that the membrane has been perforated and a false passage made; and if this be true of the normal eye, how much more difficult is it likely to be when the membrane is swollen, congested, and softened from disease? In such cases bleeding invariably occurs, and sometimes, it is to be feared, the bone is perforated and broken in the vain attempt to pass a probe in a wrong direction. Then, again, the operation of slitting up the canaliculus, whilst allowing the passage of larger probes with ease, and enabling strictures of the nasal duct to be dilated, is yet by no means always successful, and gives but small assistance when dead bone can be felt. In making the section, it is certain that parts of great importance from a physiological point of view are divided, since it not infrequently happens that, although probes of large size can be passed with the utmost facility through the aperture thus made into the sac and down the nasal duct, the flow of tears is as troublesome as before; apparently because the exhausting or compressive action of the fibres of Horner's muscle or of the orbicularis muscle upon the fluid in the lacus lacrymalis has been destroyed.

It is well, therefore, to commence the treatment of mucocele, especially if the sac can be emptied and its contents discharged into the nose by moderate pressure with the finger, by resolvent local and general remedies. The surgeon may assure himself of the patency of the puncta and canaliculi by the careful and slow passage of a No. 1 or 2 of Bowman's probes, injury to the parietes being avoided as far as possible, since it is certain to increase the evil and perhaps to induce an attack of acute inflammation of the lacrymal sac.

Hot poultices, and especially the application of dry warmth in the form of bags of heated chamomile flowers, hops, or bran, are often of great service. The injection of water or of some medicated solution, by means of a fine Anel's syringe introduced a little way into the canaliculus, may then be tried. The best collyria to be injected are a 5 per cent. solution of boracic acid, and weak solutions of iodine, alum, copper sulphate, and potassium iodide; or a small quantity of an ointment composed of one grain of atropine sulphate, five grains of mercury binoxide, and one ounce of vaseline, may be inserted between the lids. Good results are stated to have been obtained by blowing iodoform into the canaliculus and lacrymal sac. An examination should, in every case, be made into the conditions of the mucous membrane of the nose, as it is not improbable that some cases of chronic dacryocystitis proceed from extension of inflammation in that region, and that, by the cure of the primary affection, the state of the lacrymo-nasal passage may be improved or at least rendered more amenable to treatment. At the same time attention should be paid to the health. The general and dietetic regimen for struma and scrofula, with which the disease is so often associated, should be insisted on; and cod-liver oil, quinine, iron, warm or cold salt-water baths, country air and the removal of the depressing influences of late hours, excessive smoking, and the abuse of alcohol, are important points in the treatment.

When these measures fail, and it is clear that some obstruction exists in the lower part of the lacrymal sac or nasal duct, the passage of a probe must be attempted and dilatation effected.

With this object in view, fine probes may be passed down the canaliculi and the lacrymal sac, the diameter of the probes being gradually increased until the largest that can be made to enter the puncta have been introduced. If still no passage can be obtained, the canaliculus of the upper or lower lid may be divided for a part of its length, which allows the entrance of a larger probe and the more easy application of injections. In the event of this proceeding failing, it is expedient at once to proceed to perform the operation of slitting up the canaliculus along its whole length, which was originally proposed by Sir William Bowman. Since the inferior canaliculus is the most important in the process of draining off the tears, it is prudent to attack the superior canaliculus, which has the advantage of being in a more direct line with the sac, and thus permitting the passage of a probe, after its division, more easily.

The Method of Bowman.—This plan of treatment has the great advantage of enabling the surgeon to deal directly by means of large probes with strictures of the nasal duct or lower part of the lacrymal sac, without making any unsightly wound in the face. It consists in introducing through the superior or inferior punctum lacrymale and along the corresponding canaliculus a sharp-pointed small probe, which is grooved for about half an inch from the extremity. As soon as the point has entered the lacrymal sac, and is felt to touch its inner wall, it is withdrawn for a short distance, and either a probe-pointed knife or a Graefe's linear or other narrow-bladed knife is placed in the groove of the probe, which is turned towards the free surface, and is made to traverse a part or the whole of its length. By this means the canaliculus is slit up and converted into a groove or channel, and a straight or slightly bent probe can now be often at once passed down the nasal duct, breaking down or distending any obstruction that may have prevented the passage of the tears. The quantity of blood lost is sometimes very small, but occasionally the hæmorrhage is sharp for so small an operation, in consequence of the division of the angular artery. It is requisite to separate the lips of the little wound with a probe for one or two mornings after the operation, to prevent union from occurring. Some operators, with the same object in view, remove a small strip of the posterior edge of the wound with scissors, or touch the wound with oil or glycerine for a day or two.

In cases of simple obstruction, the passage of a moderate-sized probe through the nasal duct is sufficient to effect a cure; but when the bone is carious or necrosed, it is advisable to introduce a style, which is a straight piece of silver of the thickness of an ordinary dressing probe, and about an inch and a half in length. One end is smoothly rounded off, the other is enlarged into a head, or is sometimes bent like the handle of a walking-stick, to prevent its slipping into the dilated sac, an accident that has not infrequently occurred, though without serious consequences. The style may be worn for several days, being removed each morning in order to be cleansed. Weber has recommended the employment of elastic bougies as a means of dilatation of the duct. These have a diameter of one and a half millimètres at their extremity, but increase to a diameter of four millimètres, and on being introduced forcibly dilate the passage. Laminaria bougies have also been employed, which being introduced in the dry state absorb water, swell, and thus forcibly dilate a stricture. The objection is that they are brittle, and have been known to break off at the point where they were compressed by the stricture, the lower fragment blocking up the canal below this point, and being then exceedingly difficult to remove.

The Method of Weber.—In this method of treatment, reliance is placed on the action of a conical sound to break down or forcibly dilate the stricture. Weber employs a very small probe-pointed knife, with a cutting edge of about one-third of an inch in length and a breadth of blade of one-twelfth of an inch. The lower lid being drawn outwards, and thus put on the stretch, the small button at the end of the knife is introduced into the punctum, and the canaliculus slit up for the greater part or the whole of its length; the conical sound is now gently pressed down the lacrymal sac and nasal duct.

The Method of Stilling.—This is founded on the supposition that the obstruction to the flow of tears is due to the presence of valve-like folds and rugæ in the sac and nasal duct, the free division of which leads to the formation of cicatrices. The contraction of the cicatrices obliterates the folds, and the patency of the passage is restored. Stilling first slits up the canaliculus with a probe-pointed Weber's knife, and then introduces, through the wound thus made into the sac, a peculiarly shaped knife, which has a triangular blade about half an inch in length and with a width of one-eighth of an inch. It is strong and substantial, with a thick back, sharp cutting edge, and blunt point. This is made to pass down the nasal duct, and is then partially withdrawn so as to incise the mucous membrane. The blade is then turned about a quarter round, again pressed down and withdrawn, and, by a repetition of this manœuvre, a series of vertical incisions is made in the mucous membrane of the lacrymal sac and nasal duct. This method is sometimes termed stricturotomy, or better, stenositomy. The method may, of course, be combined with the injection of medicated solutions and with the employment of probes.

A different mode of performing stenositomy is, after previous slitting up of the canaliculus, to introduce a knife with a concealed blade or lacrymotome down the nasal duct; pressure on a spring causes the blade to protrude, and the section can be made in any desired direction.

When, after slitting up the canaliculus, dead bone can be felt on the introduction of a probe, the sac should be washed out with some disinfecting solution, as a 3 per cent. solution of resorcin, and then a fluid injected, consisting of equal parts of glycerine and iodoform, with a little water, two or three times daily. The dead bone sometimes slowly disintegrates, whilst, at others, a fragment may become detached, and if felt to be loose may be cut down upon and removed.

In a paper read before the Chicago Society of Ophthalmology, Dr. Hotz recommends that the treatment of lesions of the lacrymal sac should be effected by means of medicated gelatine bougies, having the thickness of Bowman's probes numbered from 2 to 6. The materials with which the gelatine is impregnated are iodoform or carbolic acid (*Journ. of the Amer. Med. Assoc.*, January 26, 1884). Such means would probably be serviceable where there was only disease of the mucous membrane; but in a considerable number of cases, especially when the patient has suffered from lacrymal abscess which has been allowed to maturate and burst spontaneously, the lacrymal bone, or ascending process of the superior maxillary bone, is necrosed, and in such cases the free slitting up of the canaliculus seems to be the only means of cure.

Dr. Gorecki has quite recently recommended and practised an operation to which he has applied the term dacryocautery. In the performance of this operation, he first slits up the superior or inferior canaliculus, then introduces into the nose, through the nostril, a canula, made of silver or platinum, resembling a tracheotomy canula, which is connected with the positive or carbon pole of a battery. A Bowman's probe is then passed down the canaliculus, lacrymal sac, and nasal duct, and a pair of spring forceps in connection with the negative or zinc pole is attached to it. A galvanometer is introduced into the circuit in order that the completion of the current may be recognised. The current, which proceeds from a Grenet's battery, having an electro-motive force of 2,028 volts, is then passed; a luminous shock is felt, followed by tickling in the nose and the formation of a few bubbles of gas. A small mass of inspissated mucus forms round the sound at the inner angle of the eye, but scarcely any pain is felt. In a very short time the sound can be felt to be less tightly grasped, and a larger probe can be immediately passed.

ACUTE INFLAMMATION OF THE LACRYMAL SAC, DACRYO-CYSTITIS PHLEGMONOSA.—In a large proportion of cases this disease is preceded either by epiphora or by mucocele, but occasionally, as in some forms of eruptive fever, it occurs when the lacrymal passages have previously been healthy. It commences with a sensation of heat at the inner angle of the eye and dryness of the corresponding nostril. A swelling soon appears in the region of the lacrymal sac, which is exceedingly tender to the touch: red and hard at first, it quickly presents the characters of an abscess, and in the course of three or four days matures. At this time the swelling and redness may extend over the cheek and nose. The conjunctiva is inflamed, the lids become puffy and œdematous, there is severe throbbing pain, and, if seen for the first time at this period, the affection is often mistaken for erysipelas. In old and weakly patients, and especially in women during lactation, there may be considerable constitutional disturbance; rigors, foul tongue, nausea, frequent pulse, and sleeplessness being common symptoms. The matter now approaches the surface, the skin becomes purple at the most prominent part, and if left to itself at length gives way at one or more points, allowing the discharge of thick pus, sometimes mingled with membranous shreds of dead tissue. The symptoms now recede, the area of redness diminishes, the pain subsides, the lids resume their normal volume, and vision, prevented by their swelling, again becomes possible.

A *lacrymal fistula* may remain, opening either on the cheek or in the sac of the conjunctiva, though in general the wound heals and a scar alone remains to show where the abscess broke. In most cases that have been allowed to run their course unchecked, some part of the bony parietes of the lacrymal sac becomes necrosed, and in some instances still more serious results have been observed, such for example as orbital abscess, and even meningitis. The treatment is identical with that of an abscess in any other region. In the first instance, hot bread and water or linseed-meal poultices should be applied, and an emetic of thirty grains of ipecacuanha, with or without a grain or two of potassio-tartrate of antimony. Active emesis, with the administration of full doses of quinine, will often arrest the progress of the disease, and will in all instances facilitate the subsequent treatment. If pus be evidently present, and fluctuation can be perceived, a free opening should be made into the sac, and this may either be accomplished by entering the point of a Graefe's linear knife opposite the inner canthus of the eye and cutting in a curved direction downwards and outwards, or a grooved probe may be introduced into the canaliculus, and the sac opened by slitting up this passage. A Weber's probe may then be passed down the nasal duct, and the original cause of the disease may thus in some instances be removed. Finally, an injection of solution of carbolic acid containing 1 to 2 per cent. of the acid may be injected, and a tent, wetted with the same fluid, may be inserted.

Injuries of the Lacrymal Sac and Nasal Duct are occasionally met with as the result of direct violence. In such cases the bones adjoining the canal are often fractured, and in the first instance hæmorrhage and emphysema, and subsequently epiphora, are observed. The emphysema may cause considerable swelling of the lids, and is recognisable by its doughy feeling and its crepitation. The occlusion of the lacrymo-nasal canal, which results from fracture and leads to epiphora, is difficult to treat. The course of the canal is altered, its diameter is diminished by projecting portions of bone, and callus may be thrown out to an extent which completely obliterates the passage. The introduction of a probe then becomes extremely difficult or impossible, and if undue force be used, sharp hæmorrhage may occur from laceration of the mucous membrane, and the bone may even be penetrated. Henry Power.

LACTATION, Disorders of. *See* Breast, Diseases of the.

LAPARO-ELYTROTOMY.—This is an operation proposed as a substitute for Cæsarean section, and for the delivery of the child when this is impossible by the natural passages, either from contraction or deformity of the pelvic bones, from obstruction due to some pelvic tumour, or to disease of the cervix uteri.

In 1806, Jörg suggested cutting through the abdominal wall by an incision extending from the spine of the pubes to the anterior spine of the ilium, then cutting through the vagina, and delivering through the os uteri. In 1820, Ritgen proposed the same operation, but whereas Jörg proposed to cut through the peritoneum, Ritgen advised lifting it out of the way. Ritgen is said to have performed the operation with a fatal result. In 1822, Physick of Philadelphia again proposed the operation, and in 1823, A. Baudelocque, jun., attempted to perform it, but abandoned it and performed the Cæsarean section.

In 1870, Dr. Gaillard Thomas, of New York, performed the operation upon the dead subject several times, and believed that the idea had originated with himself, until his attention was called to the literature of the subject. In the same year he performed the operation, and delivered a living child, but both mother and child died in a few hours. Dr. A. J. C. Skene, of Brooklyn, then operated three times; in the first case the child's head had been already perforated, and the mother died in seven hours; in the second case both mother and child survived, but the former had a small vesico-vaginal fistula as the result of the operation; this was afterwards closed by operation, and she was well in 1876; in the third case both mother and child survived, but again there was a vesico-vaginal fistula, which healed spontaneously. Eight years later Dr. Thomas operated successfully; but again the bladder was injured, and a fistula resulted, which healed without operation.

Operation.— Dr. Thomas advises the operator to be provided with a pocket case of instruments, an anæsthetic, Barnes's dilators, and Paquelin's cautery, or the ordinary cautery-irons.

The patient is laid upon her back upon a firm table, and the os is fully dilated with Barnes's dilators. The abdominal parietes are incised on the right side, from the spine of the pubes, along the upper edge of Poupart's ligament, to the anterior superior spine of the ilium. When the peritoneum is reached it is lifted out of the way. The operator or an assistant passes his finger from the vagina through the dilated os, and pushes up the vagina, which is incised from above at its junction with the uterus. The opening in the vagina is then enlarged by tearing it downwards, and the child delivered through the abdominal wound; by version, if the head or arm present, by extraction, if the breech do so. The placenta is then delivered, and the uterus made to contract firmly. The wound is cleansed by a stream of carbolised water poured through it, and escaping by the vagina. Hæmorrhage is checked by ligatures, by the cautery, or by tampon. The abdominal wound may be left open or closed by sutures, a track being left for drainage. Antiseptic syringing of the wound and vagina is employed afterwards, if necessary. The application of Listerism to the whole procedure, with a light antiseptic packing of the vagina during the early days after the operation, would certainly decrease the risk.

The advantages claimed for the operation are that it avoids opening the peritoneum and incising the uterus, and is easy and rapid; but it does not seem, so far, to have made much way with obstetricians, and has been rarely performed.

J. Knowsley Thornton.

LAPAROTOMY FOR INTESTINAL OBSTRUCTION.—This operation consists, essentially, in making an opening into the cavity of the abdomen. In cases of intestinal obstruction it has been performed as an exploratory operation; it has been used as a means of treatment in strangulation by bands, &c., and through slits and apertures; in strangulation by the true diverticulum or an adherent appendix, &c., in all forms of internal hernia, in reduction *en masse* after external hernia, in all forms of volvulus and of intussusception. By its means, obstruction due to impacted foreign bodies has been relieved, and also that due to compression of the bowel by tumours &c. situate without the intestine. It is made a preliminary to such other operations as enterotomy and resection of the intestine.

The operation of laparotomy should always be performed with antiseptic precautions. The incision should be made in the middle line between the umbilicus and the pubes, and should be large enough to allow the whole hand to be at once introduced into the abdomen. The median incision is better than an incision made over the supposed seat of the obstruction. The former incision is simple, involves no large planes of connective tissue, cuts through no vessels of any magnitude, disturbs no muscular tissue, and is readily adjusted. Through it, the whole abdomen can be explored and the intestine well examined. It can be made, moreover, independently of a very precise diagnosis. The bladder should be emptied before the incision is made, and, in cases where firm pelvic adhesions exist, it is well to make out its position with a sound. When the abdomen is opened, the intestines must on no account be allowed to protrude. They must be retained by flat sponges wrung out of warm carbolised water. If the distension of the bowels is so extreme that there is difficulty even in introducing the hand, the distended loops may be punctured in many places with a capillary trocar. When the hand has been introduced, the first part to be sought for in an obscure case is the cæcum. If the cæcum is flaccid and empty, then the obstruction must be in the small; if it is greatly distended, then it will be in the large intestine. In the latter instance, the fingers must be carefully passed along the whole length of the colon, from the cæcum to the rectum, in search of the obstruction. In the former instance, the fingers should be passed into the pelvis to make search for flaccid loops of small intestine which are *below* the obstruction. If such be found, they must be followed up until the obstruction is reached. In any obscure case every hernial orifice should be examined from within.

If a slender band is found, it may be torn through with the finger. Larger bands and most omental cords should be secured with a double ligature, and then divided between the two threads. A narrow pipe-like diverticulum may be treated in the same way. Large diverticula, especially when disposed to gangrene, should be excised near their point of origin from the bowel, and the wound closed by many points of Lembert's suture. In cases where the appendix vermiformis has to be divided, its cut end may be secured by a single ligature or by several points of suture. If an intussusception be found, it should be, when possible, reduced. This is effected partly by traction and partly by squeezing the lower end of the invaginated mass, so as to press the intussusception out of the sheath.

After the operation, the peritoneal cavity should be carefully sponged out and the wound in the parietes united in the same manner as the wound after ovariotomy. In laparotomy for intestinal obstruction exclusive of intussusception, the mortality, as estimated from 122 recorded cases, is 63·1 per cent. The fatal result would appear to depend, not so much upon the cause or site of the obstruction or the age of the patient, as upon the time at which the operation is performed and the state of the bowel when relief is attempted. The most serious factors in the procedure are delay, and the evil practice of regarding laparotomy as a last resource. In many cases it should be the first, since it is really the only resource. The mortality of laparotomy performed for intussusception is 72·7 per cent., as estimated from 33 recorded cases. Here, the fatal issue depends very conspicuously upon the time at which the operation is performed and the state in which the invagination is found. Thus, the mortality, in cases where the reduction of the intussusception had been easy, was 30 per cent., while the mortality, in cases where the reduction had been difficult or impossible, was no less than 91·3 per cent.

Frederick Treves.

LARDACEOUS DISEASE. *See* Albuminoid Degeneration.

LARYNGEAL CARTILAGES, Fractures of the, are produced by direct violence, such as an attempt to strangulate, a blow, or a fall against some projecting object. The thyroid cartilage is most frequently broken, and usually in the median line. Adults are more liable to the injury, on account of the rigidity of their cartilages. Repair may follow either by bone or by fibrous tissue, but the injury is often fatal, especially when the cricoid has been fractured.

The *symptoms* are pain in the seat of injury, swelling, ecchymosis, and some alteration of the natural shape of the parts. The voice is husky, or altogether lost. There may be coughing, hæmoptysis, and dyspnœa. The patient is sometimes unable to swallow. Upon manipulation, abnormal projections or depressions may be felt, with mobility of parts of the cartilages, and crepitus may sometimes be detected. The surgeon, however, should remember that a crackling sensation may be conveyed to the fingers when the healthy larynx is rubbed against the vertebræ. In some cases, the dyspnœa does not occur until the submucous tissues have become inflamed.

Treatment.—The patient should be kept lying down, and he should not be allowed to speak. Liquid food should be given, and, if swallowing is painful or disturbs the fragments, it may be necessary to use the œsophageal tube or nutrient enemata. An attempt should be made, if there is any displacement of the fragments, to reduce them, and to maintain them in position by pads of lint and strapping. An ice-bag may be applied to check hæmorrhage and diminish inflammation. When there is dyspnœa, and especially if this should be accompanied by hæmoptysis, laryngotomy or tracheotomy should be immediately performed. After the air-passages have been opened, and before the tube is tied in, the opportunity should be taken to explore with a probe the condition of the parts above, and as far as possible to restore them to their normal relations. In many cases, laryngotomy would be the preferable operation, as, if there was any difficulty in retaining the cartilages in their proper position, it would be easy to extend the incision upwards, and, after exposing the fragments, to fix them in their place by a few sutures.

N. Davies-Colley.

LARYNGITIS, including *acute laryngeal catarrh, acute laryngitis, hæmorrhagic laryngitis, œdematous laryngitis, traumatic laryngitis, abscess of the larynx.*

Causes.—Acute inflammatory affections of the larynx may be produced by the influence of the weather, especially in persons of sedentary habits and indoor occupations; excessive use of the vocal organs; extension of a similar affection from neighbouring parts, notably from the pharynx; inhalation of hot and irritating vapours; entrance of foreign bodies into the larynx; scalds, corrosive poisons. They often accompany the acute exanthemata, especially measles. Acute œdematous laryngitis may either represent a most violent type of acute catarrhal inflammation of the larynx (though this is extremely rare) or be due to blood-poisoning (erysipelas); or be propagated from neighbouring parts, especially from the pharynx; or occur in the course of syphilitic and tubercular inflammations, carcinoma, perichondritis and diseases of the cartilages of the larynx; of renal affections, typhoid fever, smallpox, &c.

Pathology.—In slight cases, there is merely injection of the vessels, increased succulence of the epithelial layer, and some swelling of the mucous membrane. With the intensity of the inflammatory process the exudation increases, and in the œdematous form sometimes assumes extraordinary proportions. In laryngitis resulting from corrosive poisons even gangrene may supervene. Abscess of the larynx consists in a circumscribed collection of pus in the submucous tissue of the part.

Symptoms and Diagnosis.—The subjective symptoms of acute laryngitis, in adults, vary from slight soreness in the throat, with hoarseness or aphonia, cough and expectoration (which is at first simply mucous, and only towards the end of the attack becoming somewhat purulent), to severe and even fatal dyspnœa, accompanied by stridulous respiration and cyanosis, in cases of œdematous and traumatic laryngitis, and of abscess of the larynx. In hæmorrhagic laryngitis there is sometimes sanguinolent expectoration. In children, even in comparatively slight cases, the dyspnœa is often very marked, especially at night, and the prominent respiratory difficulty, in these cases, often leads to the disease being confounded with spasm of the larynx or with laryngeal diphtheria. Whether this form of dyspnœa be due to spasm of the adductors of the vocal cords from inflammatory irritation or to collection of inspissated mucus in the narrow rima glottidis of the child, is somewhat uncertain.

The objective symptoms—i.e. the laryngoscopic signs—of acute laryngitis are the following: There is general hyperæmia of the mucous membrane; the vocal cords are more or less congested, and more or less covered by the swollen ventricular bands. Sometimes, the mobility of the cords on attempted phonation is deficient, this being due either to the swelling of the soft parts, or to slight inflammatory changes within the laryngeal nerves and muscles. In hæmorrhagic laryngitis, the bleeding spot may sometimes be detected. In œdematous laryngitis, either the whole organ or a part of it may be affected. The looser the tissue, the more readily is it infiltrated; hence, acute œdema of the larynx affects most often the lax arytæno-epiglottidean folds; after these the submucosa of the epiglottis, the mucous membrane of the arytænoid cartilages and the arytænoid fold, and, least frequently of all, the vocal cords. The appearance of the œdematous parts is most characteristic. Their colour is either of a bright or of a pale transparent red—sometimes grey; the epiglottis is changed into a round, sausage-like body, the two halves of which sometimes appear to be squeezed the one against the other; the arytæno-epiglottidean folds and ventricular bands sometimes attain such enormous dimensions as to meet in the middle line, and, with the swollen epiglottis, prevent inspection of the lower parts. Similar changes obtain in those rare cases in which the vocal cords are affected. The changes in laryngitis from scalds and from impaction of foreign bodies are very similar to those of simple œdematous laryngitis. In abscess of the larynx it will sometimes be possible, when it points, to see the yellow colour of the pus shining through the swelling, and the want of symmetry in the swollen parts may, even earlier, be of assistance in forming a correct diagnosis, but generally it will be difficult to diagnose this form with certainty.

In simple cases of laryngeal catarrh, in adults, the subjective symptoms will generally suffice to enable the practitioner to arrive at a correct diagnosis without the aid of the laryngoscope, though its use is of course always to be recommended. Matters are entirely different in the more serious, especially in the œdematous, forms. All the symptoms present in such cases (violent dyspnœa, aphonia, dysphagia, pain, &c.) are neither sufficient to make the diagnosis conclusive nor to indicate the proper moment for surgical interference. All or most of these symptoms might be produced by the impaction of a foreign body in the larynx, by a retropharyngeal abscess, by laryngeal diphtheria—in fact, by anything leading to narrowing of the upper air-passages; whilst in other cases, in which the acute œdema is secondary to another laryngeal disease (syphilis, tuberculosis, perichondritis, carcinoma, &c.), it will be of the greatest importance to make out the nature of the primary affection. In most cases, therefore, of this sort, laryngoscopic examination will be indispensable in order to arrive at a precise diagnosis. In children, even in simple laryngeal catarrh, there will be occasionally considerable difficulty in differentiating this affection from spasm of the glottis (laryngismus stridulus) and from laryngeal diphtheria. The most satisfactory solution of the problem will also, in these cases, be afforded by laryngoscopic examination. If this, however, be impossible, it ought to be remembered that in catarrhal laryngitis there is often slight fever, with impairment of the voice and cough, even during the intervals of the spasmodic attacks; that in laryngismus stridulus the intervals between the attacks are quite free, that there is no fever, and that there are sometimes carpo-pedal contractions; that in laryngeal diphtheria there is often a corresponding affection in the pharynx, and that occasionally fragments of false membrane are coughed out.

The differential diagnosis between laryngitis and laryngeal diphtheria in children, however, is sometimes excessively difficult during the earlier stages, the graver disease often beginning with simple catarrhal symptoms. It will, therefore, be advisable in such cases to wait a while before giving a positive diagnosis.

Treatment.—Simple laryngeal catarrh tends to resolution, and it is only necessary to enjoin *complete rest* of the inflamed organ. This is of greater importance than any medical treatment. Cold water applications to the neck and sucking small pieces of ice will often, if used at the very onset of the affection, check its further progress. At a later period warm steam inhalations, to which some compound tincture of benzoin, lupulin, or coniin, may advantageously be added, are sometimes useful. If the catarrh affect the nose, pharynx, larynx, and bronchial tubes simultaneously, general diaphoresis often shortens its duration. No local applications of any kind ought to be made during the acute stages. They only come into play when the catarrh, instead of tending to resolution, passes into a subacute or chronic state. See *Chronic Laryngitis.* Gargles and lozenges are of exceedingly little use in laryngeal affections. Children suffering from acute laryngeal catarrh ought to be kept indoors, and in an atmosphere rendered moist by means of a bronchitis kettle. If there be much cough, the mistura scillæ composita of the Throat Hospital Pharmacopœia [Oxymel scill. ♏xv., vin. ipecac. ♏v., tinct. camph. comp. ♏xx., aq. ad f℥j., one or two teaspoonfuls for a dose] will prove a good remedy. In hæmorrhagic laryngitis, the direct application to the bleeding spot—if this can be laryngoscopically detected—of a solution of tannic acid or perchloride of iron will often at once arrest the hæmorrhage. If the exact source of the bleeding cannot be detected, inhalations of a cold perchloride of iron spray (gr. iij.–x. ad aq. f℥j.), cold water compresses round the neck, sucking pieces of ice, and absolute rest of body and larynx are recommended.

In all forms of acute œdematous laryngitis very active treatment is required. The diagnosis having been established by laryngoscopic inspection, but little time should be lost with internal remedies and external applications. If the administration of an emetic, ice internally and externally, leeches to or blisters and mustard poultices around the neck, fail to give relief within a short time; and if, on the contrary, the symptoms of stenosis and carbonic acid poisoning increase, an energetic scarification of the œdematous parts, especially of the arytæno-epiglottidean folds, ought to be made by means of Mackenzie's laryngeal lancet, or of a long sharp-pointed bistoury enveloped, except at its point, in adhesive plaster. The writer has in several cases seen the progress of acute œdema of the larynx checked and the necessity for tracheotomy avoided by this operation, which is not difficult of execution. Should the practitioner, however, be unable to perform it, or should it not soon be followed by considerable abatement of the symptoms, tracheotomy ought to be undertaken without delay, and if promptly performed it will save the patient's life. (As to the after-treatment of that operation, *see* Tracheotomy.)

Abscess of the larynx ought to be opened as soon as possible from within, under the guidance of the mirror, by means of the laryngeal lancet. If it be very large and there be the danger of the patient being suffocated by the escape of pus into the lower air-passages, it might be necessary to perform tracheotomy as a prophylactic measure, and to insert a tampon-canula into the trachea before the abscess is opened from above.

Chronic Laryngitis.—*Causes.*—Many of the causes leading to acute inflammatory affections of the vocal organ produce, when continually acting, or when the acute stage is neglected and no rest be given to the inflamed part, chronic laryngitis. The most frequent causes are, exposure to influences of temperature, persistent use of the voice when the larynx is acutely inflamed, excessive use of stimulants, extension of a similar affection from the pharynx.

Pathology.—Tumefaction of the affected parts, due to hyperplasia or dermoid metamorphosis of the mucous and submucous tissue, increase of the connective tissue, enlargement and tortuosity of the small vessels, in much developed cases occasionally denudation of epithelium, very rarely amounting to superficial ulceration. A particular form, in which swelling of the mucous follicles is said to be the prominent feature, has been described as granular, glandular, or follicular laryngitis. In another rare class of cases, hypertrophic indurative changes are most pronounced in the subglottic region.

Symptoms and Diagnosis.—The symptoms are hoarseness, rarely amounting to complete aphonia and varying in intensity, early fatigue of the voice ; sometimes cough with a little tenacious expectoration, sometimes absence of all subjective sensations, sometimes sensations of dryness, heat, pricking, soreness, &c. In the subglottic form aphonia is often complete, and there is, corresponding to the amount of hypertrophy and to the degree of the narrowing of the glottis, more or less urgent dyspnœa. The laryngoscope shows either a general or a more partial thickening and congestion of the mucous membrane. The colour of the congested parts, however, is not so bright and uniform as in acute laryngitis, but darker and more irregular. Sometimes the ventricular bands are so much swollen as to entirely conceal the vocal cords ; sometimes the latter appear irregularly thickened, showing ecchymotic patches or swellings. In other cases, the mucous membrane in the inter-arytænoid space is thickened, and, being squeezed on attempted phonation between the inner surfaces of the arytænoid cartilages, mechanically prevents the complete juxtaposition of the vocal cords.

In subglottic laryngitis, the tumefaction sometimes appears in the form of a second whitish, greyish, or reddish vocal cord underneath the true vocal cord ; sometimes, an almost complete sphincter-like projection below the cords is perceived ; sometimes, several projections underneath different parts of the cords or under the anterior commissure are seen.

For a correct diagnosis, laryngoscopic examination is indispensable for almost all chronic laryngeal affections : neoplasms, perichondritis, syphilis, phthisis, nervous disorders, &c., being accompanied by symptoms closely resembling those of chronic laryngitis. On the other hand, the laryngoscopic appearances described above are quite characteristic of chronic laryngitis, and the only point not to be lost sight of is that chronic laryngitis does not necessarily occur as an independent disease, but also in the course of other affections (typhoid fever, acute exanthemata, syphilis, &c.).

Treatment.—It is the writer's firm conviction that neither gargles, nor lozenges, nor inhalations, nor internal treatment, nor visits to watering-places, &c., alone will ever cure chronic laryngitis. There being actual changes in the histological conformation of the parts, the only rational treatment consists in changing the torpid inflammation into a reactive one by the local application of strong astringent remedies, and to watch the course of this until its natural termination in resolution has been achieved. With this view, in more recent cases applications of a solution of chloride of zinc (15-30 grains to the ounce) ought, under the guidance of the mirror, to be made to the larynx by means of a suitably curved camel-hair brush, or of a small sponge safely attached to a properly bent probe. Instead of the zinc, perchloride of iron, alum, or tannin solutions may be used. The best remedy, however, in these cases, especially in long-standing ones, is nitrate of silver, which may be employed in solutions of 16, 24, 48 grains to the ounce. In very severe cases still stronger solutions (96 grains to the ounce), or even the solid stick, may be required. It is, however advisable, in every case, to begin with the milder solutions, and only gradually to pass on to the strength which is deemed necessary in the individual case. The initial irritability becomes soon diminished, and stronger solutions may then be safely applied. To prevent spasm of the glottis following the introduction of the brush, the patient is to be advised, before the application is made, to stop breathing for a second or two altogether, and then to begin again to breathe quite superficially through his nose. His attention being thus diverted, the spasm is almost always avoided. Drinking a little cold water relieves in all instances the spasm, if it should occur. The application should be made daily, if necessary in increasing strength, until a lively reactive inflammation is produced. The intervals are gradually to be made longer, and weaker solutions must be applied, according to the individual case. If there be a corresponding pharyngeal affection (granular pharyngitis), it is essential that this should be simultaneously treated. The treatment leads as a rule to speedy improvement even in old-standing cases, but ought to be continued until the last trace of the thickening and congestion of the parts has disappeared, there being a great tendency to recurrence unless the affection has been entirely stamped out. Sometimes, the improvement proceeds to a certain point and then becomes arrested. In such cases, it is well to combine the astringent applications with the use of electricity in both its forms—the constant and the faradic—to the sides of the larynx. If, on the other hand, the hyperplastic process should already have resulted in the formation of a well-defined neoplasm, astringent treatment is perfectly useless; the attempt to treat the growth by caustics is even injurious to the neighbouring parts, and the case belongs to the sphere of surgical interference. *See* Larynx, Growths in the.

During the whole of the often lengthy treatment, rest of the voice, discontinuance of excess in spirits, tobacco, &c., must be strongly insisted upon; disobedience in these respects leading almost invariably to its failure. It is, however, neither advisable nor necessary to altogether interdict moderate smoking and use of alcohol. Only in cases of general plethora is the regular use of some aperient (Friedrichshall water) indicated; otherwise no constitutional treatment is required. Inhalations may be looked upon as merely an aid to the rest of the treatment; the writer has little faith in them in these cases. If ordered at all, soothing steam inhalations, with the addition of some compound tincture of benzoin, lupulin, coniin, or oleum pini sylvestris are to be used. The patient is to wash his neck and chest in the morning with cold water, to wear flannel underclothing, but not to wrap up the neck. A good aid towards a lasting cure is a visit to a suitable watering-place (Ems, Reichenhall, Ischl, Royat, Mont Dore, &c.) after the conclusion of the local treatment.

In the subglottic form of disease, the treatment is more difficult than in common chronic laryngitis, and the prognosis much more unfavourable. Unless the measures recommended in the common form—which must in these cases be pushed still more assiduously—be successful, methodical dilatation by means of Schrötter's hollow vulcanite tubes, scarification, or galvano-caustic reduction of the hypertrophic parts will have to be resorted to; if, in spite of all these measures, the dyspnœa increases to an alarming degree, tracheotomy must be performed, after which operation the attempts at dilating the strictured portion may be resumed either from above or from the tracheal opening.

Felix Semon.

LARYNGOSCOPY.—To examine the interior of the larynx, a small mirror attached to a long handle must be introduced into the patient's throat. The reflecting surface of the mirror is to be directed obliquely downward, and a powerful light is to be thrown upon it, when the light will be reflected into the larynx and the laryngeal image will be visible on the mirror.

The light used may be either natural (sunlight, diffused daylight), or artificial (electric, lime, gas, lamp, candle-light). The stronger it is the better, especially for the examination of the more minute pathological changes and of the lower parts of the air-passages (sub-glottic cavity, trachea). The examiner should, however, acquire facility in examining with diffused daylight, which is preferable to the poor artificial illumination often offered to him in the private residences of patients. For use in the consulting-room, Mackenzie's rack-movement lamp, in which a plano-convex lens is placed in front of the flame, thus increasing the intensity of the light, is to be recommended.

The rays of light are thrown into the throat by means of a circular, slightly concave mirror, the so-called 'reflector,' about 3½ inches in diameter and of a focal length of 14 inches. This is attached by means of a ball-and-socket joint either to a spectacle frame, or to a frontal band which the operator affixes to his forehead. The spectacle frame possesses the additional advantage that myopic or hypermetropic practitioners can have their glasses fastened to it. The reflector should be perforated in its centre by a small oval opening, and, when in position, the long diameter of the perforation should correspond to the long axis of the observer's eye. The small mirror, attached at an angle of about 120° to a long shank and handle, is made in several sizes, of which the practitioner should have at least three (½, 1, 1½ inches in diameter); the largest size possible should always be used. Strict attention to the following mode of procedure is advised. The patient is to sit on a common chair opposite the observer, the lamp used for illumination being placed at the patient's left side on a table (or held by an assistant) near to the patient's left ear. For a satisfactory illumination it is essential that the centre of the source of light, the centre of the patient's mouth when opened, and the centre of the reflector should be as nearly as possible on one and the same level. Neglect of this fundamental rule is one of the most fertile sources of failure among beginners.

The patient is now told to open his mouth, and the practitioner throws a disc of light from the reflector into the throat, so that the centre of the disc falls upon the uvula. The patient is then directed to put out his tongue, and the anterior part of the organ is enveloped in a small soft towel, and held between the thumb (above) and the forefinger (below) of the practitioner's left hand, the forefinger and other fingers resting on the patient's chin. The mirror is warmed over the lamp previous to its introduction, to prevent the expired air condensing on it. The proper temperature is obtained as soon as the film, which at first forms on its reflecting surface, is seen to disappear. To obviate, however, applying the mirror when too hot, the practitioner should never introduce it without having tested its temperature by applying it to the back of his hand. The patient is now instructed to breathe quite naturally, and the mirror—its handle being held like a pen—is introduced in the mesial line of the patient's mouth, and quickly moved forward until its upper border touches the base of the uvula. During the act of introduction the mirror is to be held horizontally, the reflecting surface looking downwards, and the shank of the instrument being close to the left angle of the patient's mouth. Touching the tongue or the faucial pillars should be carefully avoided. As soon as the mirror is beneath the uvula, it ought to be turned upwards until its reflecting surface forms an angle of 90° with the horizon. In this position it is gently but firmly raised, until its upper border is at the same height as the base of the uvula, that organ resting on the posterior surface of the mirror. According to the optical law that, when rays of light fall on a plane surface, the angle of reflection is equal to the angle of incidence, the horizontal rays of light falling from the frontal reflector at an angle of 90° are reflected in an equal angle—i.e. vertically downwards; the larynx, which is just beneath the mirror, is illuminated, and its image, in turn, appears in the mirror, where it is seen by the observer. The use of the writer's electric laryngoscope (see *Lancet*, March 1885), in which the source of light, a small incandescent lamp, is close to the little mirror, and is actually introduced into the patient's throat, does away with the difficulty of double reflection.

It ought to be noted that the only inversion which takes place, under these circumstances, is one in the antero-posterior direction; the parts in reality in front of the larynx (e.g. the epiglottis, the anterior commissure of the vocal cords, &c.) appear in the upper part of the mirror, whilst its posterior constituents (e.g. the arytænoid cartilages) are visible in the lower part of the mirror. But there is no lateral inversion—that is to say, the vocal cord which appears in the left side of the mirror (reckoned from the *observer*)—i.e. on the *patient's right* side—is in reality the patient's *right* vocal cord, and *vice versâ.* In cases in which the whole larynx comes into view, the image thus obtained comprises, in the upper part of the mirror, the epiglottis, of which generally the free border and the upper surface are seen, further down the vocal cords (their white colour vividly contrasting with the other parts of the larynx), between them the subglottic cavity, and a part, varying in length, of the anterior wall of the trachea. At the sides of the vocal cords, the ventricular bands (false vocal cords) are seen; between the vocal cords and ventricular bands a small rim, the opening of the ventricle of Morgagni. The ventricular bands are continuous externally with two projecting folds of mucous membrane, the arytæno-epiglottidean folds, and outside these a cavity becomes visible between them and the lateral wall of the pharynx. This is the hyoid fossa or the sinus pyriformis, a part surgically important, because it is one of the seats of predilection for the lodgment of foreign bodies finding their way into the air-passages. Posteriorly,—i.e. in the lower part of the mirror—the arytæno-epiglottidean folds end in the arytænoid cartilages, and often the cartilages of Wrisberg and Santorini can be recognised in the outline of these folds.

The laryngeal image seen in the mirror is, however, by no means always so complete as that just described. It will be often necessary to move the mirror slightly, or to let the patient draw his head further back, or to let him produce the sounds, *ah*, *eh*, *e*, in order to obtain a satisfactory view. The following faults should be avoided: undue haste, attempts at examination without having concentrated the light properly, violent pulling of the patient's tongue, clumsy introduction of the mirror (at times insufficiently warmed, at others overheated), inducing irritation of the tongue and fauces, omitting to tell the patient that he must breathe quietly, holding the mirror too long in the patient's throat, neglect of the little manœuvres sometimes necessary to make a pendent epiglottis rise. This list does not exhaust all the causes of failure due to the fault of the operator, but only includes those which, in the experience of the writer, occur most frequently and are especially to be avoided. On the side of the patient the most common difficulties are: nervousness, over-sensibility of the pharynx, unruliness of the tongue, enlarged tonsils, an elongated uvula, and—most serious of all—a pendent epiglottis. All these difficulties can, however, be overcome by tact, gentleness, perseverance, the application of suitable instruments, and above all by continuous practice. In cases of exceptional irritability, and especially when intra-laryngeal operations are to be performed in nervous persons, the patient may suck little pieces of ice from fifteen to twenty minutes before the examination takes place. Recently, the local application of hydrochlorate of cocaine (in 10 or 20 per cent. solution) by means of a brush to the palate and pharynx has been found to be an excellent aid, in cases of hyperæsthesia of these parts. Local anæsthesia comes on a few minutes after the application, and lasts ten to fifteen minutes.

In conclusion, it is recommended that the signs offered by the inspection of the larynx be taken in the following order: (*a*) colour, (*b*) structural changes, (*c*) functional changes (mobility of the parts). As regards (*a*), it may be remarked that the vaso-motor changes in the larynx are very rapid, so that anæmia present on the first introduction of the mirror may, on its second, have given way to normal coloration, and to hyperæmia on its third introduction. Isolated laryngeal anæmia being a valuable diagnostic sign, it is advisable to make it a rule to devote the first glance into the larynx to the ascertainment of this inconstant factor, whilst the lasting features of the image—i.e. questions appertaining to structural and functional changes—may be safely left to a repetition of the inspection.

As regards (*b*). Under this head we shall have to look for swelling, thickening, abscess, œdema, ulceration, dislocations, malformations, new growths, foreign bodies, &c.

As regards (*c*). No definite conclusion concerning the mobility of the parts—i.e. the functions of the larynx—can, as a rule, be gained unless the larynx has been examined during phonation as well as during respiration. Failure to comply with this fundamental rule will lead to the overlooking of laryngeal paralysis, in many cases.

Felix Semon.

LARYNGOTOMY.—The term is used, in this country at least, to describe the artificial opening of the larynx through the crico-thyroid membrane. The Germans speak of this as 'partial laryngotomy,' to distinguish it from 'complete laryngotomy,' which we call thyrotomy (*see* Thyrotomy). Certain advantages were formerly claimed for this procedure, the chief of these being the facility and rapidity with which the operation could be performed. The limited space, the proximity of the vocal apparatus, the difficulty in fitting a suitable tube, detract, however, from the value of this operation. In children under twelve years of age, owing to the smallness of the larynx, and especially of the crico-thyroid space, it is quite inapplicable; while, in adults, the circumstances which call for it in preference to any other operation are but rarely met with.

Laryngotomy may be indicated when a ready and convenient access to the larynx is required; but there are few occasions when this operation is specially called for. The impaction of a foreign body, some cases of polypus and of localised morbid growths at or about the upper orifice of the cricoid cartilage, cases of laryngeal spasm (as in epilepsy or tetanus), some cases of drowning (to facilitate emptying of the lungs and subsequent artificial respiration), would, among other cases and causes, suggest and justify its adoption.

The Operation.—Unless the dyspnœa is very urgent and the patient partially insensible, an anæsthetic should be given. Ether causes increased bronchial secretion, which in many cases would be a serious drawback; chloroform should therefore be used. In administering it, especially in children, the surgeon should proceed very slowly at first, and allow the patient to sit up or lie down, as most agreeable to himself; a constrained position leads to a greater sense of suffocation, to struggling, and so to venous engorgement of the neck. A feeling of drowsiness quickly supervenes when a few drops of chloroform are slowly inhaled on a handkerchief; the dose may be gradually increased until narcosis is complete. The patient should then be placed in the recumbent position, with the shoulders resting on a cushion and the head thrown back. The thyroid cartilage is felt for with the left index finger; from its lower margin a vertical median incision, about one and a half to two inches long, is made through the skin and fascia, which are then to be retracted with blunt hooks; the crico-thyroid membrane now comes into view in the middle line, covered on each side by the crico-thyroid muscle, and must next be incised. Some surgeons make a horizontal, while others prefer to make a vertical incision through the membrane; this incision may even include the cricoid cartilage, the term 'laryngotomy' being still strictly applicable to the operation. If the vertical incision be adopted, the crico-thyroid artery, which crosses the membrane, is sure to be cut, and may possibly give rise to troublesome hæmorrhage; it should be taken up with forceps and be either twisted or tied. The advantage of this incision is that it can be prolonged either upwards or downwards, should circumstances render such a proceeding desirable. In this manner, a 'partial' laryngotomy can be converted into a 'complete' one, or into a laryngo-tracheotomy; moreover, a vertical incision interferes with the integrity of the larynx less than a transverse one, which almost necessarily includes the crico-thyroid, and possibly the lateral crico-arytænoid muscles. Especially in cases where a tube must be subsequently worn, do the advantages of laryngo-tracheotomy become obvious; for a tube can be worn more comfortably in the trachea than in the larynx.

After-treatment, &c.—The reader may refer to what has been said under this heading in the article on Tracheotomy. It will suffice to state here that the after-treatment, in any given case, is determined by the lesion calling for the operation, rather than by the operation itself. After the removal of foreign bodies, for instance, the wound will probably heal without any trouble within a few days. *Complications* may occur as after tracheotomy. As regards the voice and the vocal apparatus, they are more likely to be interfered with after section of the crico-thyroid membrane than after a simple tracheotomy, by reason of their greater proximity.

Robert William Parker.

LARYNGO-TRACHEOTOMY. *See* Laryngotomy.

LARYNX, Extirpation of the (Laryngectomy).—Extirpation of the larynx is sometimes practised in cases of malignant disease. The operation was first carried out on the human subject by Dr. P. H. Watson in 1866, on account of cicatricial narrowing of the larynx. Subsequently, Billroth of Vienna removed the larynx and upper rings of the trachea for carcinoma; the man lived seven months, dying from recurrence of the growth, which commenced about four months after the operation. Bottini operated very successfully for sarcoma of the larynx; the man recovered and resumed work. Foulis successfully operated on a man with a soft papilloma; this patient lived two years. One of Thiersch's cases lived three years and seven months. A few others have lived for two months and upwards. When death has not actually occurred from the effects of the operation itself, recurrence or spread of the disease has always taken place sooner or later. Thus, it may be said that, unless the disease is strictly localised, little is gained by extirpating the larynx; whereas death may occur directly from it. On the whole, tracheotomy is a more hopeful palliative measure than laryngectomy.

The Operation.—The patient being anæsthetised, and in a reclining position, a vertical incision should be made in the median line of the neck from the hyoid bone to the isthmus of the thyroid gland; the soft structures are then to be carefully dissected from the larynx. When exposed, the trachea may be cut across and raised up out of the wound; into its distal extremity a suitable canula is to be introduced and so fixed that, while it prevents the entrance of blood, respiration can go on undisturbed. The larynx is then gradually detached from its connections, beginning *from below*; this greatly facilitates the operation, for, as the hæmorrhage gravitates away from the part actually being operated upon, the surgeon can see what he is about. It is very desirable to take up all the bleeding vessels one by one as they come into sight, and tie them with carbolised or sublimated silk. Care must be taken not to button-hole the œsophagus. In some of the recorded cases, owing to unexpected implication of the pharynx, portions of the latter have had to be removed with the larynx. After the operation is completed, the hole may be plugged with absorbent antiseptic wool or gauze; this must be changed twice, or oftener, daily, and such lotions or other applications used as each individual case seems to call for. Should recovery take place, an artificial larynx may be fitted. Liquid nourishment must alone be given at first; this is best administered through a soft œsophageal tube, provided with a funnel-shaped extremity.

The *prognosis* in all these cases must be very guarded. Apart from the fact that the operation is most frequently undertaken for carcinoma, there are grave risks attending it; should these be got over, there is considerable risk from the onset of septic pneumonia during the subsequent two or three weeks; while, later, the fear of relapse, of recurrence, or of secondary growths, can never be quite banished.

Robert William Parker.

LARYNX, Growths in the.—A. Non-malignant Growths.

Causes.—All the causes leading to chronic inflammation of the mucous membrane of the larynx (see *Chronic Laryngitis* under Laryngitis) appear to favour the development of neoplasms in that part. This explains the fact that the male sex is, according to all experience, more liable to the disease than the female. Sometimes, no doubt, the disease is congenital, in other cases the etiology is quite obscure. Whilst some forms (especially papillomata) are met with in early infancy, and no period of life is exempt from such affections, benign growths in the larynx are probably most commonly met with in middle life—i.e. between the ages of thirty and fifty. Although, even in much more advanced periods of life, benign neoplasms occur, yet, if the history of the patient shows that the disease *commenced* after the fiftieth year of life, the surgeon will do well to remember the probability of the growth being malignant.

Pathology.—The benign neoplasms met with in the larynx are: papillomata, fibromata, cysts, myxomata, angiomata, adenomata, lipomata, and enchondromata. Of these the first two are by far the most commonly met with; cysts, though by no means so rare as believed up to recent date, following at a very long interval, and the remaining forms being excessively rare.

1. Papillomata.—Papillomata of the larynx consist of papillæ occurring singly or in groups. Their colour is white, grey, or pink, their form mostly cauliflower-like or warty. After extirpation they tend to recur. They may be solitary or multiple, pedunculated or sessile, unilateral or bilateral. Sometimes, multiple papillomata fill almost the whole larynx. The favourite seats of the growth are the vocal cords—in the experience of the writer especially their anterior commissure—the ventricular bands, and the ventricles of Morgagni. They often spring from the lower surface of the true cord, but never from the interarytænoid fold.

2. Fibromata.—Laryngeal fibromata consist of bundles of white, closely interwoven fibres, covered generally with squamous epithelium, and supplied more or less richly with blood-vessels. Their consistence is much harder than that of papillomata; their form round, oval, or multilobular, and their surface generally smooth; their colour white, pink, scarlet, or, in rare cases, bluish red; their size varies from that of a pin's head to that of a hazel-nut. They may be either pedunculated or sessile. They are almost always solitary, spring usually from one of the vocal cords, grow very slowly, and sometimes become arrested in growth after having attained a certain size. When extirpated they do not recur.

3. Cysts of the larynx are almost always of the nature of follicular retention cysts. They grow most frequently from the back of the epiglottis, the laryngeal ventricles, and from the free borders of the vocal cords, and are generally filled with either serous or colloid material. Their walls are in most cases thin, so that they can be easily pricked. Occasionally, however, the walls are firm, and offer considerable resistance to cutting instruments. Their appearance is generally that of a greyish, somewhat transparent bladder; their size usually varies from that of a pin's head to that of a small cherry; but the writer has lately seen an epiglottidean cyst — the largest, he believes, ever observed—which was of the size of a bantam's egg. After pricking they either at once collapse or slowly give exit to a tenacious colloid fluid. Sometimes they fill again after having been emptied, and in such cases they not rarely change into blood-cysts.

The remaining forms of benign laryngeal neoplasms occur so rarely, that it must suffice to mention that, in quite exceptional cases, new formations of mucoid, vascular, fatty, glandular, and cartilaginous tissue have been observed.

Symptoms.—The symptoms caused by non-malignant laryngeal tumours depend upon their seat, their size, and their mode of attachment. The vocal cords and their neighbourhood being most frequently the seat of origin of these neoplasms, hoarseness or aphonia is the most frequent symptom. In cases of pedunculated neoplasms, which are swung to and fro by the respiratory current of air, these vocal symptoms are often of a surprisingly varied character, the natural or only slightly altered voice of the patient being present whilst he speaks one sentence, and the next sentence being produced in a toneless whisper, because the neoplasm has in the meantime been thrown upon or between the vocal cords. If a neoplasm situated within the glottis be at all large, or if there be numerous small growths (papillomata) encroaching upon the air-passages, there will, in addition, be more or less considerable dyspnœa, sometimes to a dangerous extent. Again, in cases of pedunculated growth, even if not very large, the neoplasm may, especially during sleep, be suddenly impacted in the rima glottidis and produce a dangerous attack of suffocation. Dysphagia is only present when a growth (cyst) springs from the epiglottis or—in excessively rare cases—extends from the larynx into the œsophagus. Cough is by no means a frequent symptom of laryngeal growths; it is only troublesome in cases of pedunculated tumours, which are thrown about and irritate the mucous membrane after the manner of foreign bodies. Pain is not produced by benign growths.

Diagnosis. — Hoarseness, dysphonia, aphonia, dyspnœa, being concomitants of many chronic affections of the larynx, a certain diagnosis can in most cases only be arrived at by a laryngoscopic examination. Occasionally, a small piece of a papilloma may be coughed out and settle the nature of the ailment; again, the character of the dyspnœa or of the vocal disturbance may vary so much as to lead to a suspicion of its cause, or the patient himself may feel the movements of a pedunculated growth in his throat. But such cases are exceptional, and generally the discovery of a growth will come as a surprise upon both medical attendant and patient.

It is essential, in these cases, that the laryngoscopic examination be not limited to the observation of the larynx during phonation and respiration, but that it be repeated immediately after the patient has been directed to cough, because there are cases of subglottic pedunculated growths, in which the neoplasm can only in this manner be brought into view.

As to the aspect of the different forms of the more common benign neoplasms in the laryngeal mirror, sufficient information has been given in the paragraph dealing with their pathology.

The differential diagnosis between benign and malignant tumours (epitheliomata, sarcomata) of the larynx occasionally offers very serious difficulties. Epithelioma in its early stages—i.e. before the commencement of ulceration—sometimes looks strikingly like papilloma. The presence or absence of a distinct line of demarcation between the neoplasm and the neighbouring tissue; the degree of mobility of the vocal cord, if to this the growth be attached (see *Malignant Growths*, Symptoms); the age of the patient; the presence or absence of spontaneous pain, of tenderness of the larynx on handling, of tumefaction of the neighbouring lymphatic glands, of dysphagia, of hæmorrhages, of cachexia will, in such cases, sometimes give valuable information as to the true character of the neoplasm. Removal of a small fragment of the growth by means of the laryngeal forceps and its microscopic examination will, in most cases, at once settle all doubts. If this measure be impracticable, it will be wiser to leave the diagnosis for some time in suspense.

The laryngeal excrescences of syphilis and of phthisis can hardly be mistaken for non-malignant new formations. The existence of condylomata of the larynx is still doubted by many competent observers. The submucous origin of gummata, which are also very rare, and which occur in the form of smooth, roundish, yellowish, or pinkish elevations, is very obvious even on casual observation. The so-called 'false excrescences' of laryngeal syphilis, which, it is true, resemble in form some genuine neoplasms, but which in reality only represent ragged borders of ulcers seen *en profile*, are distinguished by being almost always situated in the interarytænoid fold — a situation in which, as stated above, according to the experiences of the most trustworthy observers, genuine neoplasms are never found. Moreover, in such cases there will be either concomitant lesions in other parts, or scars pointing to old mischief of a specific nature, and the history as well as the use of antisyphilitic remedies will soon clear up the diagnosis.

The general tumefaction, soon followed by ulceration, of laryngeal tuberculosis, coupled, as it almost always is in such a stage, with evidence of pulmonary disease and constitutional symptoms, will hardly lead the most inexperienced observer to mistake it for a benign growth.

Treatment.—There are cases of laryngeal growths, in which small neoplasms (especially fibromata) are so situated as to cause very little or no inconvenience. In such cases, operative removal may certainly be dispensed with, and the patient ought only to submit himself periodically to inspection, in order that the progress of the growth may be kept under notice.

In the much more numerous cases, in which neoplasms cause greater inconvenience or even danger, operative interference is indispensable. It has already been mentioned (see *Chronic Laryngitis*, under Laryngitis) that treatment of well-defined neoplasms by astringent or caustic applications is not only useless, so far as the destruction of the growth is concerned, but even injurious to the healthy parts in their neighbourhood. Moreover, the introduction of strong caustics into the larynx always implies a certain risk, leading, as it often does, to spasm of the glottis, and sometimes to violent inflammation of the adjacent parts.

Thus, removal of the growth is left as the only efficient mode of treatment. Such removal can either be effected from within under the guidance of the laryngeal mirror, or from without—i.e. by opening the laryngeal cavity; or, in rare cases, by a combination of these two methods—viz. tracheotomy, followed by intralaryngeal removal. The question which of the two methods, the intralaryngeal or the extralaryngeal, is the preferable one has been hotly discussed for years, and even now no general consensus of opinion has been obtained, though undoubtedly the intralaryngeal method is in the ascendant. It is impossible in the limited space at the writer's disposal to discuss the merits of both methods at any length. He unhesitatingly gives the preference to the intralaryngeal removal in all cases in which its execution is feasible, and his experience has taught him that this is possible in most cases. It has been contended that some qualities of certain growths, such as broad bases, vascularity, hard consistence, subglottic position when large, multiplicity and tendency towards recurrence, formed so many contra-indications to the adoption of the intralaryngeal method. The writer's personal experience has convinced him, that even the joint occurrence of several of these conditions in one case, often presents no insuperable obstacle to successful intralaryngeal extirpation. Of course, if there be urgent dyspnœa, and immediate intralaryngeal relief be unobtainable from whatsoever cause, palliative tracheotomy ought to be performed; but the writer would strongly advise that the division of the thyroid cartilages in such cases be not proceeded with at once, on account of the serious danger of lasting impairment of the voice which, in the majority of cases, follows the performance of that operation. *See* Thyrotomy.

Here comes in the vexed question of the recurrence of multiple papillomata. It has been maintained that thyrotomy offered, apart from being a quicker method of treatment than intralaryngeal evulsion of the growths, a better chance of thoroughly removing all of them, and of effectually cauterising their bases, thus giving a greater protection against recurrence. To this it must be replied that the uncontroverted statistics of Professor Bruns of Tübingen have shown these statements to be altogether unfounded on fact, and that they have brought out, in addition, most clearly the important fact that thyrotomy is in itself an operation seriously jeopardising the voice. The writer would add that frequently, in this question, two very different conditions are confounded under the one name 'recurrence.' It is an altogether different thing whether, from the same place from which a papilloma has just been removed, a fresh one springs up; or whether, after the removal of a papilloma from the anterior commissure of the vocal cords, another one begins to grow from one of the laryngeal ventricles. The latter event is evidently no 'recurrence' in the proper sense of the word, though often wrongly thus denominated, but evidence of a tendency to general papillomatous degeneration. It is obvious that unless, under such circumstances, all the contents of the laryngeal box be cut out or the larynx be entirely extirpated—two proceedings against the performance of which in such cases the writer would emphatically protest—no operation can give a guarantee against the appearance of fresh growths in the larynx. But it is equally obvious that, under such circumstances, the performance of an operation ought to be avoided, which, like thyrotomy, carries with it a grave danger of lasting impairment to the voice. The writer has found that if, in cases of multiple recurring papillomata, the intralaryngeal removal be perseveringly proceeded with, almost always, finally, a time arrives when the tendency to a fresh formation of these growths appears to become exhausted. The statement, that protracted intralaryngeal operations have been instrumental in converting a benign into a malignant tumour, has never been supported by valid evidence.

As to the practice of intra-laryngeal operations, the writer considers it neither necessary nor even desirable to give detailed directions. The method can only be learned by continued practice on the living subject, not from mere descriptions; its very essence—viz. that the operator must constantly transfer, in his mind's eye, the parts seen in the antero-posteriorly *inverted* image to their real position—demanding quite a special education. The recent introduction of hydrochlorate of cocaine as a local anæsthetic of the laryngeal mucous membrane—a 20 per cent. solution being applied by means of a camel-hair brush to the larynx five minutes before the operation, and this application, if necessary, being repeated once or oftener during the sitting—will no doubt greatly facilitate the more general adoption of the intralaryngeal method. Removal of growths may be effected by cutting, by crushing, by evulsion, and by galvano-cauterisation, but it is impossible to lay down any general rule as to the method to be employed. The writer has found, in the great majority of his cases, that evulsion by means of Mackenzie's cutting laryngeal forceps did all that was necessary; in certain difficult cases, the galvano-caustic loop and burner had to be resorted to. Voltolini's method—viz. of running a little sponge firmly attached to a laryngeal probe up and down the larynx, by which process soft growths are supposed to be torn off their attachments—has not proved very satisfactory in his hands.

B. MALIGNANT GROWTHS. — *Causes.*—The causes of the origin of malignant growths in the larynx are as obscure as those of such growths in general. It is generally believed that hereditary influences, traumatic lesions, and long-continued irritation of the vocal organ may play a *rôle* in their production; the writer, who has had the opportunity of seeing an unusually large number of these neoplasms, has not been able, in a single case, to trace the origin to a distinct cause. It is doubtful whether papillomata ever degenerate into cancroids. Malignant tumours of the larynx almost always belong to the period of life after forty; the writer has seen two cases in men over eighty. The male sex is more liable to the disease than the female.

Pathology.—The malignant neoplasms met with in the larynx are carcinomata and sarcomata. Of these, the latter are very rare, the former considerably more frequent than is generally supposed. Carcinoma of the larynx is almost always primary or contiguous, never—so far as the writer knows—metastatic or infectious. This is due to the peculiar arrangement of the lymphatics of the larynx. They are very richly developed, but form quite a network of their own, and without anastomosing with the lymphatics of the neighbouring parts—as do the pharyngeal lymphatics so amply—empty themselves into four small lymphatic glands, two of which are situated underneath the greater horns of the hyoid bone, the two others at the sides of the trachea. This is practically very important, for it explains, on the one hand, why the larynx enjoys a practical immunity from infection in cases of carcinoma elsewhere in the body; on the other, why, in cases of primary intrinsic carcinoma of the larynx, the disease so long remains a purely local one, and does not infest the neighbouring lymphatics of the neck. Similar conditions obtain in laryngeal diphtheria. Hence, also the marked absence of general cachexia in the first stages of intrinsic laryngeal carcinoma.

Cancer of the larynx appears by far most frequently in the form of epithelioma, much more rarely as medullary carcinoma, still more rarely as scirrhus; the histological characteristics of these forms being the same in the larynx as those seen elsewhere in the body. The seats of predilection of laryngeal carcinoma are the ventricular bands and vocal cords. Sarcoma occurs in the round-celled, less frequently in the spindle-celled form.

Symptoms.—It is often very difficult, in the early stages of malignant neoplasms of the larynx, to differentiate them from benign ones or even from other laryngeal affections, neither the subjective nor the objective symptoms being of a pathognomonic character. Hoarseness is usually the earliest and altogether the most constant symptom. Its degree in the earliest stages—i.e. when only a small projection is seen on one of the vocal cords—is often out of proportion to the size of the neoplasm; and the writer considers it as a sign of great importance if already, at this early period, the mobility of the affected cord is considerably impaired. The latter phenomenon, which is no doubt due to the infiltrating character of the tumour, is entirely absent in cases of benign growths of similar size. With the progress of the tumefaction, the hoarseness soon changes into complete aphonia; but, on the other hand, the voice, which was already entirely lost, sometimes returns to some extent at the time when the tumour begins to break down—i.e. when a better juxtaposition of the cords is again rendered possible. Pain in the larynx may occur either at an early or at a later period, but the writer has observed cases in which this symptom was almost entirely absent throughout the course of the disease. If present, it may radiate from the throat to the ear, the irritated fibres of the superior laryngeal nerve transmitting the irritation to the auricular branch of the pneumogastric nerve; but this variation of pain is not pathognomic of laryngeal cancer. The laryngeal region is not infrequently tender on external pressure. Dysphagia is always present when the epiglottis and the arytæno-epiglottidean folds are the seat of the disease; in intrinsic carcinoma it often is absent or slight. There is nearly always a considerable increase of secretion. This is generally at first frothy, later on tenacious and semipurulent, not rarely streaked with blood; in later stages—i.e. when the perichondrium has become affected—often fetid, as is also the patient's breath. More or less considerable hæmorrhages not infrequently take place, when vessels have been laid open in the progress of the disease. As soon as the tumefaction considerably narrows the air-passages, dyspnœa makes its appearance, the degree of which depends upon the amount of obstruction caused. Cachexia is not rarely absent throughout until the patient's death, and the lymphatics of the neck often remain unattacked so long as the growth remains within the larynx proper; when, however, the cancer dips into the pharynx, tumefaction of the lymphatics underneath the sterno-cleido-mastoid muscles and of the posterior cervical lymphatics sometimes takes place. In late stages of the intrinsic variety, the larynx is sometimes found considerably broadened, in consequence of the pressure from within.

In those cases in which the disease attacks the larynx only by contiguity—i.e. in which it starts from the tongue, the pharynx, the œsophagus, the thyroid gland, the branchial fissures of the neck, &c.—the symptoms just enumerated will of course vary according to the primary seat of the cancer, and will be, moreover, complicated by symptoms peculiar to the affection of the part primarily infested. Not rarely, acute œdema of the parts in the immediate vicinity of the new growth sets in; more frequently there is some degree of chronic œdema around the tumour. In other cases the perichondrium and the cartilages themselves are attacked, necrosis of the cartilages takes place, abscesses are formed, parts of the cartilages become separated and may be expectorated, fistulous communications between the air and food passages are established, or between the larynx and the external neck, &c.

The laryngoscopic appearances in the early stages are not very characteristic, and it will be often found very difficult to differentiate commencing carcinoma or sarcoma from papilloma, fibroma, syphilitic or tubercular infiltration. Generally, malignant growths appear as cauliflower-like, semiglobular, mamillated or warty distinct protuberances; in some cases there is from the beginning more extensive infiltration, with but little projection above the surface. Later on, the extensive irregular tumefaction, which sometimes fills half or even the whole laryngeal cavity and invades all the laryngeal structures, and above all the ulceration of the tumour itself, make the appearances much more characteristic. If the disease starts from the epiglottis, that part may either be found immensely thickened or, in other cases on the contrary, almost entirely eaten away. The parts are almost always found covered by white, yellowish, or greenish slimy or muco-purulent, often fetid, secretion.

Diagnosis.—Malignant growths of the larynx may be mistaken—(*a*) for benign ones; with regard to the differential diagnosis between the two, see *Non-Malignant Growths*, Diagnosis; (*b*) for syphilitic affections. The differential diagnosis is often difficult. The previous history of the patient, the simultaneous existence of other syphilitic affections, or evidence of old syphilitic lesions in other parts of the body, will of course aid in the decision, but neither is absolutely reliable. The carcinomatous ulcer, as well as the syphilitic, is irregular, and in the neighbourhood of both there is a zone of inflammation. But the syphilitic ulcer in the larynx is generally developed very acutely, often within a few days, whilst the cancerous takes some weeks for its development. The former is almost always solitary, unilateral, and not very large; the latter is preceded by tumefaction, the traces of which remain round the ulcer. Frequently, it is covered with small excrescences, and often attains a very large size.

There are, however, cases in which all these diagnostic signs are of little value, and in these the use of iodide of potassium will often solve the doubt. The writer would propose it as a general rule, that the treatment of every case of suspected laryngeal cancer ought to begin with the administration of large doses of iodide of potassium. (Ten-grain doses three times daily, to be rapidly increased up to thirty-grain doses three times daily.) No conclusions as to the nature of the affection ought to be drawn from the patient's statements, but only from the occurrence of actual changes for the better in the laryngeal appearances; for the writer has found that, even in cases of undoubted cancer of the larynx, the patients often state, after having taken iodide of potassium for a week's time, that they feel better. In such cases, however, the progress of the growth is of course not arrested, and the drug soon loses its effect upon the subjective sensations.

(*c*) Malignant disease of the larynx may also be mistaken for tubercular affections. Here, generally, the differential diagnosis is much easier. The patient's age, the concomitance of pulmonary affections, the characteristic pallor of the laryngeal tissues, the bilateral infiltration usual in laryngeal phthisis, the slow development of the ulcers, their small size and great number, will easily differentiate this affection from malignant growth in the larynx. Examples have, however, been recorded by good observers, in which mistakes have been committed.

Treatment.—The treatment of malignant growths of the larynx is very unsatisfactory. Medical treatment is of course useless. Pain may be temporarily relieved by insufflations of morphia (gr. $\frac{1}{8}$—$\frac{1}{2}$ twice daily or more frequently). It is probable that applications of strong cocaine solutions (20 per cent. or more) to the affected parts, or the use of cocaine-sprays and tablets will also, in this disease, relieve pain and dysphagia, but up to the moment when this was written no experiences regarding this point had been recorded. If there be complete impossibility of swallowing, the patient must be fed by the stomach-pump or by nutrient enemata, unless gastrostomy be preferred. Dyspnœa being almost always present, the writer would advise the performance of tracheotomy, as far as possible from the seat of the disease, at an early period—i.e. before the general health has already suffered from insufficient air supply. The operation affords great relief to the patient, and life is prolonged on an average for a year, and not infrequently for longer. If its performance be left until the patient is almost suffocated, the results are not nearly so satisfactory.

Regarding radical extirpation of the growth, the following modes of procedure have to be considered: (1) intralaryngeal extirpation; (2) thyrotomy; (3) subhyoid pharyngotomy; (4) total—(5) partial extirpation of the larynx.

(1) Intralaryngeal extirpation is out of the question in cases of carcinoma, and in sarcoma may only be attempted in those cases in which the neoplasm forms a well-defined tumour.

(2) Thyrotomy, with subsequent extirpation through the wound, yields very bad results in cases of malignant growth, and should not be attempted.

(3) Subhyoid pharyngotomy may be thought of, in cases in which the growth is limited to the epiglottis and the parts in the laryngeal vestibule.

(4) Total extirpation of the larynx for carcinoma is at present still on its trial. According to the latest statistics, out of sixty patients operated upon for carcinoma, forty-two died, fifteen recovered, and the end of three cases is unknown. This result is certainly not very encouraging; and the question of how long the patients who recovered survived the operation, and the proportion between the length of life after simple tracheotomy and that after successful extirpation of the larynx, have still to be determined. Until these questions have been fully answered by large and reliable statistics, the propriety of extirpating the larynx as soon as the diagnosis of laryngeal cancer has been established is, in the writer's opinion, still *sub judice.* On the other hand, it is only in cases in which the tumour is absolutely limited to the laryngeal cavity, and in which no affection of the neighbouring parts is as yet present, that an early operation appears to have any chance. For, in those cases in which the lymphatic glands, the pharynx, œsophagus, thyroid gland, &c., are simultaneously or even primarily attacked, it will be almost impossible to eradicate all traces of the malignant disease, and recurrences within the next few months are almost certain. The kind of life which the patient will have to lead even after successful operation, and even with an artificial larynx, must of course be fully explained to him before the operation is undertaken. In sarcoma, the chances of complete extirpation appear to be much better. One patient has certainly survived the operation for more than six years.

(5) Partial extirpation of the larynx has of late years repeatedly been performed, especially by German surgeons, in cases in which the disease only involved one half of the larynx. It is stated to be much less serious than the total excision, not to be followed more frequently by recurrence of the disease than after complete removal of the organ, to give rise to less functional disturbance with regard to swallowing and speaking, and, in some instances, even to

enable the patient to dispense later on with the tracheal tube. Further experience, however, will have to show how far these statements can be supported. In the present state of our knowledge, the best policy would appear to be to explain to the patient or to his friends, on the one hand, the chances of the palliative treatment (tracheotomy if necessary, accompanied or followed by gastrostomy); and, on the other, those of the radical (partial or total extirpation of the larynx), and to let them decide. *See* LARYNX, Extirpation of the.

FELIX SEMON.

LARYNX, Neuroses of the.–A. MOTOR NEUROSES.

I. PARALYSES. — *Causes.* — Diminished or abolished action of the vocal cords may be the consequence of either a neuropathic or a myopathic impairment. Myopathic impairments may be due to muscular degeneration (in phthisis), to infiltration of the muscles (in inflammatory processes), or to their direct destruction (in cases of injury, malignant growth in the larynx or œsophagus, &c.); otherwise they are exceedingly rare. Neuropathic impairments may be either of an organic or of a functional nature. The latter class of cases includes functional weakness (in cases of phthisis, chlorosis, general anæmia, loss of blood after injuries, exhausting diseases, &c.), hysterical affections; and—at least in the initial stages—also the *reflex* paralyses, although, in the case of the latter, probably later on actual organic changes take place. Examples of such reflex paralyses would be: the paralysis resulting on the *opposite* side from pressure on one pneumogastric nerve, probably some instances of diphtheritic and possibly some of the forms of toxic paralysis. The reflex paralysis in the first-named class of cases has been ingeniously explained by Dr. George Johnson as the result of a centripetal irritation of the trunk of the vagus acting on the nervous centre, and through it upon the nerve-supply to the laryngeal muscles on the opposite side.

With the exception of some of these reflex paralyses, in the great majority of cases of functional paralysis the adductor fibres of the recurrent laryngeal nerves are concerned, very rarely the abductor fibres. The organic paralyses may be of a central, peripheral, perhaps also (*see* above) of reflex origin. These paralyses may be either complete or incomplete—i.e. they may either involve the whole of the motor centres or single motor nerves of the larynx, or they may be limited to parts of centres or nerve-trunks. Thus, in cases belonging to the last-named category, there may be either paralysis of the motor branch of the superior laryngeal nerve, or incomplete paralysis of the centres or trunks of the recurrent laryngeal nerves, or paralysis of inindividual twigs of the recurrent from local causes. In cases of incomplete organic lesion of the centres or trunks of the spinal accessory, pneumogastric, and recurrent laryngeal nerves, there is, as the writer has shown, a distinct proclivity of the abductor fibres of the recurrent laryngeal nerve to succumb sooner than the adductor fibres, or even exclusively; whilst the occurrence of an analogous isolated affection of the adductor fibres, in cases of organic disease, has never yet been verified.

Pathology.—In the purely functional cases, no changes are to be detected in either nerves or muscles; in the myopathic cases, the changes vary according to the fundamental cause. Thus, in cases of acute inflammation of the mucous membrane, a serous infiltration of the muscles may take place, in phthisis, fatty degeneration of the muscles may be found, whilst in a case of œsophageal carcinoma occupying the plate of the cricoid cartilage, one or both posterior crico-arytænoid cartilages may have partially or entirely perished by a process of invasion and ulcerative destruction. In cases of neuropathic paralysis due to organic lesion or disease of the motor laryngeal nerves, the atrophic and degenerative changes usually met with under such circumstances will be found in the nerves and in the muscles supplied by them, their intensity varying in proportion to the amount of the lesion. If the lesion be equivalent to a transverse section of the nerve affected, all the nerve-fibres and all the muscles supplied by the nerve will, of course, suffer in an equal degree. But it is a most remarkable fact that, even in cases of grave and long-standing implication of the recurrent laryngeal nerves in tumours or dense connective tissue, or of serious central disease involving the roots of the laryngeal motor nerves, a number of normal, well-preserved nerve-fibres has been found; and that, in such cases as stated above, the abductors of the vocal cords (posterior crico-arytænoid muscles) have invariably been found to have undergone considerable or even almost complete atrophy and fatty degeneration, whilst the adductors have either suffered to a much less degree or even entirely escaped degenerative changes.

Symptoms. — The larynx serves two functions, respiration and phonation. For the former it is necessary that the glottis should be open to a certain extent during inspiration and expiration, for the latter that it should be closed during the act of speaking, and that there should be a certain amount of tension of the vocal cords. If, in consequence of impaired abductive power, the cords cannot separate so far as to allow of a sufficient entry of air during inspiration, dyspnœa will arise; if, on the other hand, in consequence of complete paralysis of one or both recurrent laryngeal nerves, or of their adductor or tensor twigs, the vocal cords cannot be brought fully together or are not in a sufficient degree of tension when brought together, aphonia or dysphonia will arise.

The symptoms of laryngeal paralysis, therefore—apart from the symptoms of the fundamental disease which causes the paralysis—will vary very considerably according to the set of fibres attacked, and also according to whether the paralysis is unilateral or bilateral.

In *unilateral complete paralysis of one recurrent laryngeal nerve* the corresponding vocal cord stands immovably in the so-called cadaveric position—i.e. according to the measurements of the writer, about two to three millimètres from the mesial line. The other cord moves freely, and often, on attempted phonation, even crosses the middle line to join its fellow, the position of the glottis under such circumstances being oblique. The voice may be entirely lost, or impaired, squeaking, and with a peculiar tendency to breaking into falsetto on the slightest phonatory effort. There is no dyspnœa.

In *bilateral complete paralysis of the recurrent laryngeal nerves* both vocal cords stand immovably in the positions they occupy after death (cadaveric position), the voice is entirely lost, on attempted phonation the air rushes through the open glottis, and the patient soon gets exhausted if he attempts to speak, cough, or expectorate. There is no dyspnœa during repose; shortness of breath only occurs on exertion.

It has been stated above that, in case of incomplete organic unilateral paralysis of a recurrent nerve, those of its fibres which supply the abductor muscle are always first or pre-eminently paralysed. In such cases, there is at first of course only impaired abduction on the affected side; later on, however, the unopposed antagonists of the paralysed muscle fall into a state of paralytic contraction, and draw the vocal cord into the position of phonation, where it becomes immovably fixed. Under such circumstances—i.e. in the initial stages of all the severe lesions (enumerated under 'Causes') which may implicate the laryngeal nerves, and indeed not rarely up to the patient's death—in adults *neither vocal nor respiratory symptoms occur*; and the important laryngeal lesion present, which may be of the greatest importance for the correct diagnosis of the whole case, will entirely escape notice, unless a rule be made to examine the larynx in all cases in which lesions of the laryngeal nerves could occur, whether there be symptoms pointing to the larynx or not. In children, in consequence of the smallness of the glottis, even in unilateral paralysis of an abductor, fatal dyspnœa may arise.

If the conditions named in the last paragraph obtain on both sides—i.e. if there be either a bilateral incomplete lesion of the centres (e.g. in cerebral syphilis, or in tabes, or in a case of tumour of the brain); or a similar incomplete lesion of the trunks of both recurrent laryngeal nerves (e.g. in cases of goître, aneurism of the aorta, carcinoma of the œsophagus); or if there be pressure upon the trunk of one pneumogastric nerve only (*see* under 'Causes'), the result will be *bilateral paralysis of the abductors of the vocal cords.* In such a case both vocal cords will, in the manner above described, be gradually drawn towards, and finally be fixed near, the middle line. Laryngoscopically, this looks similar to a continuous position of phonation. On inspiration, the cords separate to the extent of a small rim between their inner borders, or are, in much developed cases, even drawn nearer each other by the rarefaction of air below the stenosed opening; on expiration they separate a very little as in inspiration; on phonation they come together as under normal circumstances. The result of this state of things is loud, often sonorous, inspiratory stridor, free and noiseless expiration, and normal voice. There is always in advanced cases dyspnœa, but its intensity greatly depends upon whether the stenosis has been produced gradually or more suddenly. In the former cases, it is often surprising how little subjective dyspnœa is experienced by a patient whose glottis is reduced to a diameter of not more than two to three millimètres It is obvious that, in such patients, the least swelling of the abnormally approximated parts will suffice to close the opening, and may lead to immediate asphyxia.

Paralysis of the *adductors* is almost always bilateral and due to functional disorders, especially to weakness of the muscles (as in phthisis, chlorosis, &c.), to infiltration of the muscles (as in violent catarrh or inflammation of the air-passages), to reflex causes (uterine disorders, &c.), and to hysteria. If unilateral, in which case one vocal cord would be seen not to approach the middle line on attempted phonation, whilst on deep inspiration it would be properly drawn to the side of the larynx, it is probably always the consequence of *local* injury to nerve-twigs or muscles. The voice would probably be quite aphonic, or at least exceedingly hoarse. In the bilateral cases the paralysis is rarely complete, in which case the glottis will be seen to form, on attempted phonation, a widely open immobile triangle, more frequently incomplete—i.e. on attempted phonation the cords are seen to approach, without, however, completely closing the glottis, or, if they do so, they at once recede from their juxtaposition. Thus this form is, more correctly speaking, a paresis. The result of the deficient closure of the glottis is more or less complete aphonia. Sometimes the patient is able to produce a few sounds with resonant voice; more often this is impossible; but even if the voice has been lost for months or years, coughing, sneezing, and the emotional voice-sounds (laughing, sighing) are often found to still possess their normal character. The onset of the affection is in the hysterical cases quite sudden, its duration most variable (from hours to years), its end sometimes quite as sudden as its beginning. In cases of catarrhal origin, both beginning and passing off are, in accordance with the nature of the lesion, more gradual.

Sometimes, in cases of catarrh or of hysteria, the *inter-arytænoid* muscle alone is affected. In such cases, the anterior three-fourths of the vocal cords are seen to come together on attempted phonation, but a triangular space remains open in the hindermost part of the glottis. In such cases there may be complete aphonia. The writer has never seen a case of isolated paralysis of a *crico-arytænoideus lateralis*; and though, of course, its occurrence in consequence of local lesion is theoretically quite possible, he must confess that he would be unable to distinguish it from paralysis of all the adductors on the same side.

Isolated paralysis of the *internal tensors* (thyro-arytænoid muscles) is laryngoscopically shown by an elliptic cleft remaining between the inner borders of the vocal cords on attempted phonation, and may be accompanied by more or less loss of voice. It is often associated with, or quickly follows upon, paralysis of the glottis-openers. It is, however, important to know that some elliptic gaping of the vocal cords, during phonation, is by no means rarely seen in persons who are in full possession of their voice.

Isolated paralysis of the *external tensors* (crico-thyroid muscles) may occur after diphtheria, and is, according to Mackenzie, characterised by the glottis having a wavy outline. There is, the same author states, a slight depression of the central portion of the vocal cords in inspiration, and a corresponding elevation in expiration and vocalisation. In unilateral paralysis of a crico-thyroid muscle, the corresponding vocal cord stands on a higher level than its fellow. The symptoms met with under such circumstances are more on the side of the sensory fibres of the superior laryngeal nerve (see *Neuroses of Sensation*) than of its motor fibres; but probably a deep, gruff, monotonous voice would be present.

Finally, it may be remarked that combinations of paralyses of individual muscles, with corresponding variations of the laryngoscopic image, are sometimes met with.

Diagnosis.—A certain diagnosis of laryngeal paralysis can only be made by means of the laryngoscope. Although, in cases of hysterical paralysis of the adductors or of bilateral paralysis of the abductors, the symptoms are so characteristic as to leave little doubt as to the nature of the loss of voice in the one and of the inspiratory dyspnœa in the other; yet the conditions in the former case may be simulated by general respiratory weakness, laryngeal polypi, and other forms of mechanical impediment to the closure of the glottis, in the latter by spasm of the glottis, perverse action of the vocal cords, cicatricial contraction in the inter-arytænoid fold (*see* LARYNX, Syphilis of the), and, to a certain degree, by gummatous infiltration and stenosis of the trachea. Serious errors in these respects are known to have been made. In all forms of laryngeal paralysis, the laryngoscope will therefore be well-nigh indispensable for diagnosis. The mere discovery of an immobility of one or both vocal cords, however, is not sufficient to at once establish the diagnosis of a 'paralysis;' and the surgeon must bear in mind the possibility of a mechanical fixation by cicatricial contraction of the mucous membrane, after ulcerative diseases or injuries. A very unusual position of the arytænoid cartilage and corresponding vocal cord, with absolute immobility, signs of previous ulcerative diseases, abnormal distortion of the mucous folds, and above all, tumefaction at the base of the immobile arytænoid cartilage, will favour the idea of a mechanical fixation. Several affections may lead to either mechanical fixation or to nervous paralysis, and the possibility of the combination of both forms of impairment must not be lost sight of. If the diagnosis of nervous paralysis have been established, its fundamental cause must of course be sought for.

Treatment.—In any form of *organic* laryngeal paralysis, the only indication is to remove, if possible, the *cause* of the mischief. Thus, in cases of cerebral syphilis a most energetic anti-specific treatment will have to be instituted; in cases of pressure by glands or tumours, these will, if possible, have to be removed, &c. Direct treatment of the paralysis itself, by electricity or otherwise, is, so long as the exciting cause continues to act, perfectly useless, though faradisation of the paralysed nerves and muscles, coupled with hypodermic injections of sulphate of strychnia (dose gr. $\frac{1}{30}$ gradually increasing to gr. $\frac{1}{10}$), may with advantage be adopted after its removal, in the hope that the conductivity of the nerve has not yet been wholly destroyed. In cases of bilateral paralysis of the abductors, in which considerable stenosis of the glottis has taken place and marked dyspnœa is present, unless not only subjective relief but an actual enlargement of the glottic opening has been speedily obtained by whatever method is employed, tracheotomy ought to be performed without delay; not as a curative but as a prophylactic measure, with a view to the subsequent removal of the tube in case any later therapeutical efforts should produce a real cure of the affection. Here, however, one caution is necessary. In all cases in which there is bilateral paralysis of the glottis-openers, certainly or probably due to pressure upon the nerves by tumours of the neck or thorax, it will often be impossible, with the means at present at our command, to exclude with certainty the existence of *a second stenosis lower down*, due to direct compression of the trachea or of the bronchi by the same tumour which causes the paralysis. If the laryngeal narrowing be considerable enough to give a sufficient explanation of the patient's dyspnœa, the surgeon will be warranted in operating, but he should always beforehand fully explain the situation to the patient or to his friends, to prevent disappointment in case there be a second stenosis lower down. Under such circumstances the low operation should always, if possible, be chosen, so that in case of a second stenosis lower down the tube could either be inserted below the compressing tumour—in cases of tumour of the neck—or that a long, flexible tube might be cautiously passed down, if possible, through the narrowed part of the windpipe, especially in cases of intrathoracic tumours.

In cases of functional paralysis of the adductors, through overwork of the part or general or local weakness, tonic treatment (iron, phosphorus, strychnia, arsenic) coupled with gentle galvanisation or faradisation over the region of the pneumogastric nerves is indicated. Rest of the voice should be enjoined. In cases of inflammatory origin the usual treatment of catarrh might be instituted. *See* LARYNGITIS. In reflex paralysis the distant cause (e.g. uterine trouble) ought to be looked for and appropriately treated. In hysterical paralysis of the adductors, emotional effects or anything that gives a shock to the system often produce a cure, and the same result is frequently obtained by any remedy that stimulates the laryngeal mucous membrane —e.g. by inhalation of ammonia. The most reliable and quickest method, however, consists in intra-laryngeal faradisation by means of Mackenzie's laryngeal electrode. Generally, even in long-standing cases, the voice can be restored in the first sitting. The shock given ought not to be too great, nor, on the other hand, too feeble. By timid handling of the method its effects are often spoiled, and its subsequent adoption rendered difficult. If necessary, the faradisation ought to be repeated; in the writer's experience, however, one strong application generally suffices.

In post-diphtheritic paralysis of the crico-thyroid muscles, faradisation to the muscles and hypodermic injections of sulphate of strychnia into the sides of the neck are recommended.

II. SPASMS.—*Causes.*—Excessive action of the laryngeal nerves may be due either to affections of the nerve-centres, nerve-trunks, or of single nerve-twigs. With regard to the nerve-trunk affections, it may be stated that, it having been shown that stimulation of the peripheral end of the cut recurrent laryngeal nerve—i.e. of *all* its fibres—results in adduction of the corresponding vocal cord, it is quite possible that, in cases of so-called 'spasm of the glottis' of peripheral origin, not only the adductors, but also the abductors may be in a state of spasmodic contraction, the former, however, preponderating. In spasms due to affection of single nerve-twigs, either the abductors, or the tensors, or the adductors alone may be concerned. In the case of the latter, the spasm may either occur independently of volition, and may then be (*a*) uninterrupted during the attack (common 'spasmus glottidis'); (*b*) occurring in separate contractions quickly following one another and associated with similar contractions of other expiratory muscles (nervous 'laryngeal cough'); or it may occur only on attempted phonation, when it is usually allied to spasm of the tensors ('aphonia spastica'—'speaker's cramp').

Excessive action is always the result of irritation. Such irritation may be either direct or reflex—i.e. either acting upon the motor nerves themselves or affecting other centripetal nerves, and, being transferred to the laryngeal motor centres, radiate along their centrifugal tracts, causing spasmodic contraction of laryngeal muscles. To produce spasmodic motor phenomena, the irritation must possess a certain degree of suddenness and intensity. Any of the causes usually leading to progressive paralysis of the laryngeal nerves (see *Paralyses*, Causes), may therefore, if acting more suddenly and more intensely, produce laryngeal spasm. Thus, even in a case of slowly progressive primary paralysis of laryngeal nerves, provided that the conductivity of all the fibres has not yet been destroyed, spasm may suddenly supervene, if from any cause there be a sudden increase of irritation.

Pathology.—Laryngeal spasms are in the majority of cases pure neuroses, and, with the exception of those cases in which a direct pressure upon the laryngeal nerves is shown by the post-mortem examination to have existed, no changes either in the nerves or in the muscles are to be detected.

Symptoms.—The symptoms in cases of spasm due to affection of the nerve-trunks, and of the common form of the affection of the adductor twigs in which the contraction is uninterrupted during the attack (common spasm of the glottis), are identical, they may therefore be described together. The symptoms, however, differ to some extent in the cases of children, when the affection is also called 'laryngismus stridulus,' and in those of adults.

In children, often without any preliminary symptoms, a few at first short, gradually more prolonged, stridulous inspirations are followed by closure of the glottis, suspension of the respiratory movements of the chest, and complete cessation of respiration. This cessation, unless the child succumbs during the attack, lasts from a few seconds to about two minutes, and ends with a series of stridulous inspirations, after which regular respiration is gradually re-established. During the attack the aspect is a most painful one: the countenance is very anxious, the flush at first present on the face is soon replaced by pallor or even lividity, the eyes stare, the pupils are contracted, the nostrils are dilated, the head is thrown back, the neck forward, the face is covered with cold perspiration, its veins and those of the neck are swollen, and in severe cases these symptoms are accompanied by spastic, so-called 'carpo-pedal,' contractions of the muscles of the extremities. The thumbs are flexed on the palms and the other fingers closed round them or rigidly extended, the carpal joints are bent inwards, the feet somewhat flexed and rotated inwards. General convulsions are sometimes superadded to these phenomena. Attacks of this sort, but of variable severity, may follow one another at variable times. Sometimes they occur in most rapid succession, sometimes at intervals of twenty-four hours or more. The child may succumb in any of them, whilst in most cases, after a variable duration of the liability to such attacks, a complete cure is finally effected.

In adults the symptoms are similar to those just described, only generally less severe. The complete cessation of respiration witnessed in children only rarely occurs, and the attack is generally characterised by a series of stridulous inspirations. There is no doubt, however, that in cases of sudden considerable irritation of the laryngeal motor nerves, a laryngospastic attack may also end fatally in adults. In very rare cases there is, according to some authors, a slight but constant spasm. A laryngoscopic examination during the attack will, in most cases, be impossible. In the free interval, generally, no abnormality, except perhaps slight congestion, can be detected.

In the variety in which the spasmodic closure appears in the form of separate, sudden, short contractions of the adductors associated with similar contractions of other respiratory muscles, the only symptom is incessant cough of a particularly loud, sometimes barking, nature, which goes on without interruption whilst the patient is waking, and occasionally prevents him from sleeping. This nervous laryngeal cough, which is not associated with any demonstrable lesions, usually attacks young people between 16 and 20, may last for weeks, months, and even years, and finally almost always disappears spontaneously.

The last form of spasmodic contraction of the adductors, which is probably always allied to a similar contraction of the tensors, only occurs on attempted phonation, and is called 'spastic aphonia.' This form, like the preceding, is rare. There appears to be a certain proclivity to it on the part of highly strung male persons who have to use their vocal organs professionally (especially clergymen), but apparently robust males and females, whose occupation is of a silent kind, may also be attacked. It is characterised by a very peculiar alteration of the voice. Whenever the patient attempts to speak, he produces only a few sentences, words, or even syllables, in an audible voice, the rest of the sentence or word being completely lost in fruitless and distressing efforts to force a current of air through the spasmodically closed glottis. Laryngoscopically, under these circumstances the glottis may be seen to be so spasmodically closed, that it almost appears as if one vocal cord were overlapping the other. When the patient whispers, the difficulty is sometimes not so great, though not entirely absent. Respiration is free and noiseless.

Diagnosis.—Spasm of all the laryngeal muscles or of the adductors alone is so well characterised by its sudden commencement, the complete cessation of respiratory movements at the height of the attack, the absolutely free intervals, the absence of fever, cough, hoarseness, or aphonia, that these points considered together will, on the whole, suffice to prevent the practitioner from confusing it with acute laryngitis, &c.

Nervous laryngeal cough can only be confounded with cough from organic disease (phthisis). Careful examination of the chest, &c., will obviate such an error; moreover, cough from organic disease is hardly ever so continuous as the purely neurotic. Aphonia spastica is differentiated from common spasm of the glottis by its occurring only on attempts at phonation; from bilateral paralysis of the abductors by being associated with free and noiseless respiration.

Treatment.—In cases of spasmodic closure of the glottis threatening life, the first indication is to relieve the spasm, the second to remove if possible the cause of the abnormal irritability causing the spasm. During the attack, fresh air must be admitted to the room, the patient should be placed in a sitting posture, all tight clothing ought to be removed from him, cold water dashed into his face and upon his chest, strong smelling salts, ammonia, ether, acetic acid, should be held to his nostrils, and his fauces tickled with the finger or a feather until retching is produced. Inhalation of chloroform (which, of course, ought only to be administered by a medical man), or a subcutaneous injection of morphia often curtails the attack. During the interval, the exciting cause of the spasm ought to be ascertained if possible, in order to be avoided in future. The patient should be protected against all emotional disturbance; gastric and intestinal disorders should be promptly attended to; in cases of rachitis, the general hygiene and diet must be carefully regulated and cod-liver oil be given.

Nervous laryngeal cough and aphonia spastica are equally little amenable to treatment; but the best remedy, especially in nervous laryngeal cough, appears to consist in a long journey (if possible a sea voyage), or removal of the patient from his usual surroundings. In cases of nervous laryngeal cough due to irritability of the laryngeal mucous membrane, cocaine applications may possibly prove useful.

III. Troubles of Co-ordination.—Under this head it is only necessary to remark that, in some cases, a disorderly action of the vocal cords is observed. Thus choreic movements of these parts have been seen to accompany general chorea, and have even been noticed independently; a tremulous action of one or both cords, similar to the tremors of the limbs on intended movement, is sometimes seen in disseminated cerebro-spinal sclerosis, and finally, in some cases, a perverse action of the cords has been described. In this form (which has also been named functional inspiratory spasm, though it is more a trouble of co-ordination than of excessive action), the vocal cords, instead of separating on intended inspiration, approach each other, remain together during the inspiration, so that the air enters with difficulty and accompanied by stridor through the narrowed glottis, and only separate to some extent during expiration. The symptoms in such cases (variations appear to occur) will be very similar to those of bilateral paralysis of the abductors (see *Paralysis*); and it is only by watching the vocal cords with the laryngoscope during expiration, that a separation will be seen and a correct diagnosis arrived at. This affection appears to occur almost exclusively in nervous or hysterical persons, and a minor degree of the same is often witnessed in nervous people who are for the first time examined with the laryngoscope, the vocal cords being in such cases approached to one another, instead of separated, on attempting a deep inspiration. Psychical treatment, bromide of potassium, and the cold douche will often effect a cure.

B. Neuroses of Sensation.

I. Anæsthesia.—Loss of sensibility of the mucous membrane occurs when the sensitive branch of the superior laryngeal nerve is paralysed. This may arise in cases of bulbar paralysis and other cerebral affections, in diphtheria, and to a minor degree in hysteria. It may be unilateral or bilateral, and vary from a slight diminution of sensibility and reflex irritability to complete anæsthesia and analgesia. If occurring in diphtheria or bulbar paralysis, it is always coupled with motor paralysis of the depressors of the epiglottis, and often with paralysis of the crico-thyroid muscles. *See* the motor phenomena caused by this paralysis, under *Paralyses.* The upper aperture of the larynx remaining open during the act of swallowing, and the mucous membrane of the larynx itself being insensitive, under these circumstances particles of food often enter the lower air-passages, and may either cause most violent cough (the tracheal mucous membrane having retained its reflex irritability); or obstruct the passage and produce dangerous attacks of suffocation; or become impacted in the bronchi and give rise to pneumonia. A certain diagnosis can only be arrived at by touching the laryngeal mucous membrane, under guidance of the mirror, with a probe. If anæsthesia be present, the patient neither feels the touch nor is reflex cough, &c., produced. Though post-diphtheritic anæsthesia tends to spontaneous disappearance in the course of five or six weeks, in all forms in which the anæsthesia is complete, the patient ought to be fed either by the œsophageal tube or by nutritive enemata, in order to prevent the very dangerous entry of food into the air-passages. The œsophageal tube ought, under these circumstances, to be introduced very cautiously, guided by the forefinger of the left hand, in order that it may not enter into the open and insensitive larynx. When it is in what is supposed to be the correct position, the patient, before the food is administered, should be requested to produce a sound, which will be impossible when the instrument is in the trachea. As to the treatment of the affection itself, in diphtheritic paralysis galvanic and faradic electricity applied to the anterior wall of the pyriform sinus, close to which the superior laryngeal nerve is running, and hypodermic injections of sulphate of strychnia (gr. $\frac{1}{20}$ to $\frac{1}{10}$) are recommended.

II. Hyperæsthesia, Paræsthesia, and Neuralgia.—All these forms of neurosis occur very rarely in the larynx, and are, if occurring, usually combined with similar affections in the pharynx. All of them are concomitants of hysteria, hypochondriasis, neurasthenia, anemia, chlorosis, and similar affections, and may be said to pass over into one another without very sharp outlines. The sensations complained of are of a very varying kind; pain, burning, pricking, constriction, dryness, rawness, sensation of a foreign body, pressure, irritation to cough, &c. The result of the laryngoscopic examination in such cases is negative. The treatment of these affections is often very difficult and unsatisfactory. In the first place, attention must be paid to the general health, nervine and tonic remedies be given, sea-bathing or a voyage advised, &c. If the pain be of an intermittent character, quinine should be tried. Locally, applications of astringent remedies or of morphia and chloroform may be instituted; cocaine may prove itself very useful in these cases. Felix Semon.

LARYNX, Scalds of the, not infrequently occur in children from the attempt to drink from the spout of a boiling kettle. A similar effect is produced in adults and children by the swallowing of corrosive fluids, or by the inhalation of the heated vapours from flames or a gas explosion.

There is usually pallor and collapse, followed by restlessness and fever. The patient complains of severe pain about the mouth and fauces. The mucous membrane of these regions is swollen, white, and blistered. Swallowing is painful, and sometimes impossible. The voice is hoarse, or sinks to a whisper. In a short time respiration may be seriously affected from the extension of the swelling to the parts immediately above the rima glottidis, or from reflex contraction of the laryngeal muscles. This dyspnœa is subject to exacerbations, which may prove suddenly fatal. Generally, however, the breathing becomes more hurried, with stridulous inspiration and gradually increasing lividity, until the patient dies in a few hours from exhaustion or asphyxia. Where the injury is less severe, the symptoms may slowly subside, or they may be followed by those of broncho-pneumonia, even in cases in which the laryngeal disturbance has not been so severe as to necessitate tracheotomy.

When death occurs in a few hours, the mucous membrane of the mouth and pharynx, together with that part of the larynx which lies above the true vocal cords, will be found to be sodden, wrinkled, and highly congested, while the œsophagus and the parts below the rima will usually have escaped injury. Should the patient succumb at a later period, the scalded parts will be covered with croupous exudation; partially separated sloughs will be seen about the fauces and epiglottis; the bronchi will be congested and full of viscid mucus or pus; and patches of hepatisation will be dotted over the substance of the lungs.

Treatment.—The child should be placed in a bed surrounded by screens in a warm and steamy atmosphere. Sponges wrung out of hot water should be applied to the front of the neck. Calomel in 1 or 2 grain doses should be given every hour. Antimonial wine, in doses of 1 or 2 minims, with $\frac{1}{4}$ to $\frac{1}{2}$ minim of tincture of aconite, may also be given at first every quarter of an hour, and afterwards at longer intervals. If there should be any persistent dyspnœa, and especially if there should be spasmodic exacerbations, the parts about the fauces and epiglottis should be scarified with some pointed instrument, such as a needle in a handle. This gives exit to the serum of the blisters and to the submucous infiltrations in the upper part of the larynx, and in many cases the operation is followed by great relief. If, however, the symptoms still continue urgent, laryngotomy or tracheotomy should at once be performed. Should broncho-pneumonia supervene at a later period, a linseed-meal poultice should be wrapped round the chest, and expectorants be given, such as ipecacuanha wine with carbonate of ammonia. At first the child should be fed with small quantities of milk and beef-tea, and, if there is much collapse, some brandy must be added. Subsequently a more nourishing diet will be necessary. The treatment of adults will be similar to that of children. Where the patient is vigorous, leeches may be applied to the front of the neck, and, if lung-symptoms should arise, a blister to the upper part of the chest may be beneficial. N. Davies-Colley.

LARYNX, Syphilis of the.—*Causes.* The larynx may be attacked by syphilis in its secondary, tertiary, and congenital forms. The secondary manifestations appear, usually, at the time of the corresponding skin-lesions or a little later; the tertiary symptoms, as a rule, a few years after the primary infection. Both forms, however, are subjected to most striking variations; whilst in some patients a form of superficial ulcerative laryngitis will return year after year, without ever passing into the more serious forms of deep destructive ulceration, on the other hand, lesions belonging to the most severe forms of the tertiary period occasionally appear in the larynx and in the trachea a few months after the primary infection. Again, there may be an outbreak of tertiary syphilis in the larynx five, ten, twenty, even thirty and forty years after the primary infection. The congenital lesions of laryngeal syphilis were considered as excessively rare up to very recent date; lately, however, it has been shown that they are much more common than had been supposed. They usually manifest themselves either shortly after birth, or in the first years of life, or at the time of puberty.

Pathology.—Secondary syphilis of the larynx shows itself usually in the form of a very obstinate catarrh, which has nothing specific in its character, but which is looked upon by some as an erythema. The occurrence of condylomata (mucous patches) is a hotly contested point. If occurring at all, they must be rare and of a very transitory nature. Superficial ulceration, often of a relapsing character, is also met with. The phenomena of tertiary laryngeal syphilis are gummata, deep destructive ulceration, perichondritis of a suppurative or an adhesive character, caries of the cartilages, fibroid thickening and degeneration of the mucous membrane, cicatricial contraction. All these may occur separately or combined, or one following another. Gummata in the larynx are rare. They are generally developed in the submucous tissue, and appear either in the form of multiple, small, sharply defined, often nearly coalescent nodules, or in that of a diffuse infiltration, or as larger, well-defined, smooth nodes. The mucous membrane over them is at first normally coloured, but assumes later on a yellowish tint. They show a great tendency to break down and to change into deep irregular ulcers, which often penetrate very deeply, extend to the perichondrium and the cartilages, and lead to purulent perichondritis, formation of abscesses, fistulous communications with the neighbouring parts, caries, necrosis, and exfoliation of the cartilages. Apart from this form of ulceration, there is another more frequent one, and not preceded by the formation of gummata, which shows a greater tendency to extend in surface than in depth.

Again, there is a form of primary perichondritis in syphilis, in which the mucous membrane is either not at all affected or only secondarily. This perichondritis may either be of an adhesive type, or it may be of a suppurative character, and, in such cases, the mucous membrane only becomes affected at the time when the abscess breaks internally. The further consequences may be, of course, the same as in the cases in which the ulceration extends from the surface to the deeper structures. Often, there is œdema, acute or chronic, in the neighbourhood of the ulcers of both periods and of the gummata; sometimes, fungoid excrescences are found on the borders of the ulcers. These excrescences, which often look like papillomata, are especially seen in the inter-arytænoid fold, a locality in which, as elsewhere stated, genuine non-malignant neoplasms never occur, but in which isolated longitudinal syphilitic ulcers are not rarely found. On the whole, it may be said that syphilitic phenomena may show themselves anywhere in the larynx. The epiglottis, however, is perhaps more frequently attacked than any other part.

Common to all syphilitic ulcerations, whatever their particular form of origin may have been, is the extraordinary tendency to cicatricial contraction on healing and the formation of callous connective tissue. This peculiarity often leads not only to fibroid thickening and to very curious deformities of the individual parts, but also to their coalescence with each other, to the formation of membranous bridges or even of complete diaphragms between the cords or ventricular bands, to adhesion between the epiglottis and the adjacent pharyngeal structures, to extreme stenosis of the laryngeal cavity, &c.

Symptoms.—From a glance at the pathology of the possible changes in laryngeal syphilis, it will be evident that the symptoms may show almost every shade of variation peculiar to the larynx, according to the nature and the gravity of the lesions. Thus, in the secondary affection, with the exception of some hoarseness there are usually no laryngeal symptoms. There may be slight sensations of irritation or of soreness in the throat, but laryngeal syphilis, even in its most serious ulcerating forms, is characterised by complete or nearly complete *absence of pain.* Cough is but rarely present, and hardly ever very troublesome.

In the tertiary stage more definite symptoms are met with. When the vocal cords are either ulcerated or infiltrated by œdema, or fixed in an abnormal position by disease of the crico-arytænoid joints, more or less complete aphonia may be present; when there is stenosis of the larynx, from whatever cause, there will be dyspnœa, often of a dangerous degree; when the epiglottis is partly destroyed by ulceration, and if there be in addition ulceration in the pharynx or œsophagus, there may be some dysphagia, though this rarely forms a very prominent feature.

The laryngoscopical appearances will necessarily vary, almost indefinitely, according to the nature of the lesions in the individual case. The catarrhal congestion of secondary laryngeal syphilis is not very characteristic, and is only distinguished by its obstinacy. Mucous patches are described as smooth yellow projections sometimes 'round, but more often oval, varying in diameter from three to seven millimètres, but in rare cases attaining a breadth of a centimètre' (Mackenzie). The writer has never seen them. The superficial ulceration, which is most frequently intermediate between the secondary and the tertiary changes, is of a decidedly inflammatory character, and often surrounded by a more or less œdematous zone of congestion. The ulcers of the tertiary period show this inflammatory character in even a more decided manner. They are deep, with irregular infiltrated borders and an unhealthy-looking base. Sometimes, when they penetrate to the cartilages and exfoliation of sequestra has taken place, they have an almost crater-like appearance. Gummata have already been described. The congenital lesions of laryngeal syphilis may present themselves in any of the forms under which the acquired disease, in its secondary and tertiary stages, appears.

Diagnosis.—The catarrh of secondary laryngeal syphilis having nothing characteristic in its appearance, the diagnosis of its specific nature will have to be made only from the concomitant existence of undoubted syphilitic affections of the skin, the mucous membranes of the mouth, tongue, pharynx, &c. As stated before, it is distinguished by great obstinacy and resistance to purely anti-catarrhal treatment. It yields, however, quickly to anti-syphilitic measures. On the other hand, it must not be forgotten that a person suffering from secondary syphilis may acquire a common catarrh.

The hoarse voice of children suffering from 'snuffles,' broad condylomata about the anus, &c., will often lead to the inference that the larynx is also attacked, and not rarely laryngoscopic examination will verify the suspicion.

There will not, usually, be much difficulty in rightly interpreting the ulcerative and gummatous manifestations of syphilis. To begin with, in the majority of cases there will be lesions, corresponding to the stage of the constitutional disorder, in other parts of the body, the skin, other mucous membranes, the eyes, bones, abdominal organs, brain, &c., which will at once point to the nature of the laryngeal affection. Even if the latter should occur alone, the patient's history and the discovery of old scars in other parts, notably in the pharynx, will give valuable information. Again, though the laryngeal ulcer of syphilis has nothing absolutely pathognomonic about it, yet there are usually signs sufficient to render it easily distinguishable from tubercular and malignant affections, the only ones—except lupus, which is very rare in the larynx—with which it could be confounded.

The syphilitic ulcer is produced very rapidly—i.e. within a few days; it is evidently of an inflammatory origin, and has an area of more or less active inflammation around it; it is irregular, often large, often deep, usually solitary and unilateral; there are rarely more than two or three ulcers.

The tubercular ulcer, on the other hand, is usually preceded by a long period of pseudo-œdematous infiltration, the parts are usually excessively pale, semi-transparent, the ulcers are very numerous, very small, and only later on confluent; they hardly ever lead to so much destruction as syphilitic ulcers. Moreover, the concomitant pulmonary and constitutional affections will afford valuable diagnostic help. The diagnosis, however, will be sometimes excessively difficult in cases in which phthisis and syphilis are simultaneously present, or in cases in which, besides the laryngeal affection, syphilitic lung-troubles exist. As regards the latter class of cases, it will be useful to remember that syphilitic lung-affections are generally localised, not in the apices but in the middle region of the lungs. Should there be any doubt, it is better to give under all circumstances antisyphilitic remedies.

The scars, thickenings, distortions, webs, &c., left after the healing up of syphilitic ulcers as a rule tell their own tale; occasionally, however, there will be great difficulty in deciding whether immobility of one or both vocal cords is due to previous syphilitic disease and ankylosis of the crico-arytænoid articulations, or to paralysis of the motor laryngeal nerves.

Treatment.—In all syphilitic affections of the larynx, constitutional treatment is of fundamental importance. In the secondary stage, mercurial preparations (hydrargyrum cum cretâ, 1–2 grains, two or three times daily, or a mercurial pill of two grains with opium—gr. $\frac{1}{3}$—twice or three times daily) may be given; or a regular mercurial inunction treatment (half a drachm of mercurial ointment to be used daily) may be instituted. The inhalation of atomised solutions of bichloride of mercury (1 in 500 or in 1,000) has been warmly recommended. Local applications are rarely required. If such be made, solutions of sulphate of copper (15 grains to an ounce of distilled water) or of nitrate of silver (30–60 grains to one ounce of distilled water) may be used.

In the tertiary forms, in which every day unexpected and serious complications may arise, a vigorous iodide of potassium treatment is indicated. It almost always achieves brilliant results, even in cases in which from œdema, or from gummatous infiltration of the larynx and trachea, immediate danger appears to be present. It will, in such apparently hopeless cases, be sometimes possible to avoid scarification and performance of tracheotomy, when they seem to be urgently indicated, if, beginning with the administration of 10-grain doses of iodide of potassium three times daily, one gradually but quickly pushes the dose up to thirty grains three times daily, combining this internal medication with mercurial inunction.

Should there be so much acute œdema of the upper parts of the larynx and such dyspnœa, that the action of internal remedies cannot be waited for, scarification ought to be practised, and if in spite of this the difficulty of breathing continues, tracheotomy must be performed. The latter operation may also be required in cases of subglottic œdema, of chronic stenosis of the air-passages from fibroid thickening of the parts, and in cases of bilateral ankylosis of the arytænoid cartilages in the position of phonation, whereby the glottis is reduced to a narrow slit. In cases of narrowing of the larynx from cicatricial contraction, methodical dilatation by means of Schrötter's hollow vulcanite tubes may be tried; but the writer must confess that he has never been lucky enough, though he has followed this plan very perseveringly in several instances, to either avoid tracheotomy in cases in which this operation appeared to be indicated, or to enable patients, in whom that operation had been performed, and in whom dilatation was practised subsequently, to dispense with the canula. Moreover, the method is not quite free from the risk of setting up active inflammation and even suppurative perichondritis. In cases of cicatricial webs, it may be either attempted to remove them with cutting-forceps, or to divide them by means of Dr. Whistler's cutting-dilator, or to destroy them by means of the galvano-cautery. If the web, however, be very tough, no method can boast of much success, and even removal from without—i.e. after the performance of thyrotomy, with subsequent dilatation, does not protect against a sphincter-like recicatrisation. The patient will, therefore, in such cases most probably have to wear his canula for the rest of his life. FELIX SEMON.

LARYNX, Tuberculosis of the.—*Causes.*—Laryngeal phthisis is due to the deposit of tubercle in the larynx, and occurs in about 30 per cent. of all cases of pulmonary phthisis. Tubercular disease of the larynx is almost always secondary to the pulmonary affection, though it often occurs at a time when there are no definite physical signs of lung-mischief; quite recently some cases have been put on record, in which the result of the post-mortem examination seems to establish the actual occurrence of primary laryngeal tuberculosis. As regards age and sex, the same conditions obtain as in pulmonary tuberculosis.

Pathology.—The stage of deposit of the tubercle is usually ushered in by infiltration and pseudo-œdematous thickening of the tissues, which is generally most marked in the epiglottis, the arytæno-epiglottidean folds, the mucous membrane covering the arytænoid cartilages, and in the inter-arytænoid fold. This stage is frequently preceded by marked isolated anæmia of the whole mucous membrane of the larynx, especially of the epiglottis. The tubercles themselves are said to have been seen in very rare cases as small greyish or yellowish nodules, but in the great majority of instances they break down so quickly that small ulcers are usually the first signs of their presence. These quickly coalesce, extend in surface and in depth, destroy epithelium and mucous membrane, and lead to perichondritis, caries, necrosis, and exfoliation of parts of the cartilages. In rare cases subepithelial tumours, consisting of an aggregation of miliary tubercles, and cellular infiltration of the mucosa and submucosa, have been found. Even in the stage of extensive ulceration, chronic œdema of the surrounding parts usually persists.

Symptoms.—The most common special symptoms of laryngeal phthisis are cough, with more or less expectoration, hoarseness, aphonia, and dysphagia, all of which may be due to the swollen and ulcerated state of the organ. Cough may, however, also depend upon the concomitant pulmonary affection; aphonia upon implication of the right recurrent nerve in thickening of the pleura of the apex of the right lung, or upon pressure of enlarged bronchial glands upon either or both recurrent laryngeal nerves, leading to paralysis of one or both vocal cords. Cough and dysphagia are generally the most troublesome symptoms of the malady; the latter is often so extreme that it materially hastens the fatal end.

Laryngeal dyspnœa is less common. The shortness of breath on slight exertion, so often observed in these cases, is to be attributed rather to the concomitant lung-affection than to the laryngeal disease. Serious and even fatal laryngeal dyspnœa, with stridulous breathing, may however, occur, either in consequence of extensive œdema, or of impaction of a piece of necrosed cartilage in the glottis, or of mechanical fixation of both vocal cords in the position of phonation. This last may be the result of perichondritis and subsequent ankylosis of the crico-arytænoid joints, or of bilateral paralysis of the glottis-openers, in consequence of implication of both recurrent nerves in lesions of the lungs or of the bronchial glands. *See* LARYNX, Neuroses of the.

Laryngoscopically, the pallor of the tissues is of great diagnostic value. Originating even before the stage of infiltration, it persists throughout the periods of thickening and ulceration. The discovery of such a pallor should always be followed by careful examination of the lungs. In rarer cases there is an obstinate chronic laryngeal catarrh, undistinguishable laryngoscopically, at the beginning, from common laryngitis. With the onset of the tubercular infiltration the appearances often become so pathognomonic, that the diagnosis of phthisis can be made from laryngoscopic inspection alone, though, of course, examination of the lungs, of the sputum for bacilli, &c., must never be neglected. In such cases, the infiltration gives to the eye of the observer the idea of a peculiarly dense, almost semi-solid, pale œdema; one or both of the arytænoid cartilages and arytæno-epiglottidean folds, which are sometimes for some length of time the only parts thus infiltrated, assume a pear-like appearance, the larger end of the pear being represented by the pale, swollen arytænoid cartilages. The epiglottis is often rolled backwards on itself, and looks like a turban. If these pale swollen surfaces are, a little later on, seen studded with small ulcerations, the appearances are almost unmistakable. In other cases the first, and for some time the only, laryngeal symptom is infiltration or ulceration of the inter-arytænoid fold. If, in cases which otherwise warrant suspicion of phthisis, this part be seen to be swollen, velvety-looking, semi-transparent, superficially eroded, or even somewhat ulcerated, this is a sign of evil omen.

The vocal cords and ventricular bands are sometimes, but not often, the parts first affected. They appear sodden, rounded, the cords lose their lustre and become denuded of epithelium; later on, distinct ulcers are visible, their borders appear irregularly eroded, finally they may be partially or wholly destroyed. The superficial ulceration, wherever first seen, soon spreads in depth and extent. Often, the whole laryngeal mucous membrane forms a mass of ulceration covered with thick greenish-yellow secretion. The epiglottis may be, and not rarely is, almost wholly destroyed, or a small stump only is left, and one or both cords may be seen to be immovably fixed in any position, or their movements may be very defective.

Impairment of the mobility of one or both vocal cords may occur at different periods of laryngeal phthisis, and may be due—(*a*) to functional weakness of the (sometimes actually degenerated) laryngeal muscles; (*b*) to extensive infiltration of the tissues, notably of the inter-arytænoid fold, which may mechanically prevent the movements of the cords; (*c*) to actual disease of the crico-arytænoid joints; (*d*) to disease of the afferent motor nerves.

Diagnosis.—The diagnosis of laryngeal tuberculosis presents, as a rule, no great difficulty. In many cases the laryngoscopic examination will suffice; in more doubtful ones, examination of the lungs and of the sputum for bacilli will generally settle the question. In doubtful cases, especially if it be uncertain whether the laryngeal ulceration is syphilitic or tubercular, some of the secretion from the ulcerated surface withdrawn by means of a brush, under guidance of the laryngeal mirror, may be examined for bacilli, and their detection will clinch the diagnosis.

The diseases most likely to be mistaken for laryngeal phthisis are syphilis, carcinoma, chronic œdema, and simple chronic inflammation of the larynx. For the differential diagnosis from syphilis and carcinoma, *see* the articles treating of these affections. Chronic œdema occurs in the course of laryngeal phthisis, as well as in that of the diseases just named. Its greater transparency, and the absence of ulceration on the swollen parts, will usually differentiate it from tubercular infiltration. Whether an obstinate catarrh of the larynx, accompanying pulmonary phthisis, is of a tubercular or a non-tubercular nature, may for some time be doubtful. That non-tubercular catarrhal affections of the larynx may accompany tubercular disease of the lung, has been proven by post-mortem examination. The uselessness of the common treatment of chronic laryngitis, and the occurrence of more definite laryngeal lesions in such cases, may in time lead to a more accurate diagnosis of the true nature of the laryngeal affection.

Treatment.—The constitutional treatment—medical, climatic, hygienic—generally employed in pulmonary phthisis, is to be made use of in laryngeal tuberculosis. As to local medication, there are few diseases in which such a multitude of remedies has been recommended as in laryngeal phthisis. The writer will only mention those which he has found most useful. In the early stage — i.e. before ulceration occurs — he very rarely adopts any local measures. In cases of ulceration he has seen much benefit from the insufflation into the larynx once or twice daily, by means of the powder-blower, under the guidance of the laryngeal mirror, of a powder composed of iodoformi, acidi boracici, ana gr. j., morph. acet. gr. $\frac{1}{6}$–$\frac{1}{2}$, the patient having immediately before cleared the part as much as possible of mucus by coughing. In making the application the mirror must invariably be used, as unless the powder come in contact with the ulcerated surface the treatment is useless. If properly applied, however, the insufflation leads in most cases to diminution of the distressing cough, improvement of the dysphagia, and often to an actual improvement in the condition of the ulcers. In a very few cases, the writer has even seen them disappear for a time under the methodical employment of these insufflations. Quite lately, he has in a few cases of tubercular perichondritis with excessive dysphagia brushed over the whole of the affected parts with a 20 per cent. solution of hydrochlorate of cocaine, to enable the patients to swallow. The effects have been most encouraging. Cocaine may also be used in the form of spray or of pastiles. In cases of advanced œdema, energetic scarification is advised by some authors. Where there is much difficulty in swallowing, the patient's diet ought to consist of liquids thickened by the addition of some arrowroot, cornflour, or isinglass, and drinks ought to be taken at a draught, and not sipped (Mackenzie). In cases of complete aphagia it may become necessary to feed the patient by means of an œsophageal tube.

Tracheotomy ought only be performed when there is direct danger of suffocation from any of the causes enumerated under 'symptoms,' but not otherwise. The experience of the most trustworthy observers shows that when it is performed simply to give the diseased larynx rest, it does not delay the tubercular process, whilst the wearing of the canula enhances the misery of the patient's existence.

Felix Semon.

LATERAL SPINAL CURVATURE.

Scoliosis.—*Definition.*—A lateral deviation and contortion of the spinal column, nearly always accompanied by more or less exaggeration or diminution of the normal antero-posterior curves.

Causes.—Lateral curvature of the spine is predisposed to by weakness of the spinal muscles, combined with long-continued sitting or standing in stooping or careless positions, such as standing on one leg, sitting with the trunk leaning to one side, or with the thighs crossed. Another predisposing cause is inequality in the lengths of the lower extremities, the result of (1) congenital difference in size; (2) atrophy from infantile paralysis; (3) hip-joint disease; (4) congenital dislocation of the hip; (5) unequal muscular power, when one leg is partially paralysed, &c. Eliminating these causes of inequality in the legs, which are common to both sexes, there is no doubt that ordinary lateral curvature, induced by muscular weakness and injurious positions during years of growth and school life, is far more frequent in girls than in boys. This cannot be explained by girls being accustomed to sit in worse positions at school than boys, but by the fact that, as a rule, boys are allowed to correct the evil influence of stooping and lounging over lessons during long school hours, by daily physical exercise, such as cricket, football, &c., whereas girls enjoy far fewer opportunities of exercising their bodies. At the onset of puberty, the development of girls generally throws a greater strain on their health and strength than is the case with boys, and fully developed girls of twelve or fourteen years of age, suffering from lateral spinal curvature, are frequently met with in ordinary practice amongst all classes, but especially amongst the upper and middle.

It is still uncertain why the very large majority of cases of lateral spinal curvature have the upper or dorsal curve with the convexity to the right. Dismissing theories about the supposed influence of the arch of the aorta, it is very probable that the greater use of the right arm and hand is a predisposing cause; although, at the same time it must be admitted, that cases with the convexity of the upper or dorsal lateral curvature to the left are not at all limited to left-handed patients.

Weakness of the muscles is always accompanied by a corresponding weakness or softness of the bones to which they are attached. There is, besides, often an hereditary predisposition to lateral curvature, due either to inherited excessive softness of the bones, or weakness of the muscles, or to both combined. The writer knows of many cases where a mother and her daughters had more or less severe lateral curvature, and he has watched a family where father, daughter, and granddaughter by a son, had all marked lateral curvature, the father being much deformed.

Rickets is frequently associated with lateral curvature, and some of the worst deformities seen in museums are of this class, the curvature being induced either by unequal shortening of the legs from deformity, or by the excessive softness of the bones, or by these causes in combination, aided by the usual factor of weak muscles. As a general rule, anything which weakens the muscular system tends to produce lateral curvature, which often therefore follows convalescence from one of the acute zymotic diseases or a severe inflammation of the lungs. Too rapid a growth, or the too rapid laying on of fat at the time of puberty, is a frequent cause; the writer has observed that a large proportion of patients with lateral curvature are either too tall or too short, the latter condition occurring as the result of illness, which has not only weakened the muscles but also retarded a normal state of growth.

So far, ordinary lateral curvature only has been considered, but unilateral affections of the thoracic viscera, such as severe empyema in a stage of recovery with dragging down of the thoracic walls, or severe adhesions the result of old pleurisy, will also produce lateral curvature with concavity on the same side as the chest affection; in such cases, torsion of the lateral curvature is generally absent for a time.

Pathology.—Innumerable works have been written on the pathology of lateral curvature, and the most diverse views propounded as to whether it is caused by the weakness of the bones, ligaments, or muscles. Simple lateral curvature is hardly ever met with, except in cases due to empyema or severe disease of one lung. In the large majority of cases, the lateral curvature of the spine is accompanied by a rotation, on their axes, of the bodies of the vertebræ implicated in the given curvature, so that the transverse processes of the same side as the convexity of the curvature are directed backwards, while the transverse processes of the other side of the vertebral bodies, viz., towards the concavity of the curvature, are of necessity directed forwards. For example, in the common form of lateral curvature with dorsal or upper convexity to the right, and lumbar or lower convexity to the left, the right transverse processes of the dorsal vertebræ and the ribs attached to them are directed backwards. This torsion of the bodies of the vertebræ is probably caused by the muscles of the spine and trunk trying to recover the vertical position of the spine, and, failing in this, tending to partly restore equilibrium by twisting the portion of the trunk immediately above the convexity of the curvature, round to the same side.

It is difficult to say precisely whether the dorsal or lumbar lateral curvature is first established. No doubt as soon as one curvature is confirmed, a compensating curvature to the opposite side forms, and, in most cases, the head is flexed to the same side as the convexity of the dorsal curvature (cervical convexity to the left). In many cases when seen in the earliest stage, with scarcely any or no permanent osseous deformity, a distinct dorsal curvature with convexity to the right and a lumbar curvature with convexity to the left will be found, where it is but fair to conclude that the two curves began simultaneously. It is an important fact, that when once there is actual osseous deformity of the ribs and vertebræ, to that extent lateral curvature is incurable. Before a patient can become the subject of moderate or severe osseous lateral curvature, she must have passed through many intermediate stages from the first onset of the deformity, when she began to sit or stand with the spine slightly flexed to one side. At that time, if an anatomical examination could have been made, only some flabbiness or want of development of the muscles would have been found. As the curvature creeps insidiously on, the bodies of the vertebræ become gradually misshapen, so that they are more or less wedge-shaped transversely to the longitudinal axis of the spine, i.e. the vertical depth of a vertebral body will be one or more lines greater on the side corresponding to the convexity of a pathological curvature as compared with the side facing the concavity. The intervertebral fibro-cartilages also become wedge-shaped to the same or even to a greater degree. It is to be noted that the amount of lateral curvature observed by looking at the tips of the posterior spinous processes under the skin, always implies a much greater amount of actual lateral curvature of the bodies of the vertebræ. This can be easily understood by bearing in mind the rotation, on their axes, of the vertebral bodies during the formation of the lateral curvature, which tends to make the posterior spinous processes lie more and more in an imaginary vertical line, drawn through the arcs of the upper and lower lateral curves.

Lateral curvature may accompany spinal caries, or may directly result from caries of one lateral half of one or more vertebræ, but such cases are very exceptional. So also lateral curvature of congenital origin, the result of extra-lateral halves of vertebral bodies being inserted between the normal vertebræ, is extremely rare; according to Neugebauer, only thirteen such pathological specimens are on record. The osseous tissue of the spinal column, even in the severest cases of non-rickety deformity, generally appears to be quite normal; the chief pathological change, in addition to the actual deformation of the vertebræ, intervertebral cartilages, and ribs, is the frequent presence, in severe cases, of buttresses of new osseous deposits within the concavity of each lateral curvature, as a compensation for the instability caused by the deviation from the vertical line. The descending aorta, and other soft tissues, follow the severest undulating curvatures of the spine. In lateral curvature with much osseous deformity, the ribs opposite the convexity of the dorsal curvature become extremely convex posteriorly, and so flattened anteriorly that the sternal and vertebral ends of the same rib become almost or quite parallel. The corresponding ribs opposite the concavity become much flattened behind and too convex in front, causing undue prominence, and at times pseudo-enlargement, of the mamma of that side. Adjacent ribs are sometimes welded together by osseous tissue in cases of extreme deformity.

Symptoms.—Cases of lateral curvature may be divided, clinically, into two great classes: (1) where pain in the back is the first symptom observed, and (2) where some deformity, as the undue prominence of a shoulder-blade, or of an iliac crest, or general stooping, first directs attention to the presence of lateral curvature. It may be stated generally that the amount of pain complained of is seldom in proportion to the amount of deformity. Cases of extreme lateral curvature are frequently seen, where there is not and never has been any pain felt by the patient, although the health may have been affected in other ways, by indigestion, headache, shortness of breath, &c. On the other hand, life may have become almost unbearable on account of constant backache, and the symptoms almost assume those of so-called 'spinal irritation,' in cases where the curvature is but slight.

Ordinary case of Lateral Curvature.—To take an average case of the ordinary type, that is, one not due to inequality of the lower extremities or paralysis. A school-girl of fifteen has stooped more or less for several years, especially during the last three; has complained of weakness and pain in the back for two years past, which became worse after measles, one and a half years ago. Her general health has always been good. She is a short, stoutish girl, with awkward gait, anæmic; complains of pain in the lower dorsal and lumbar regions whenever she has been sitting for an hour or so; generally has pain every evening before going to bed; half an hour's walk brings on the same pain. During the last three years at school the patient has written at a flat table, sitting on a bench without a back, with the trunk in an oblique position.

Mode of Examination.—Both boots should be taken off, and the clothes covering the trunk removed, a petticoat being fastened round the pelvis, well below the crista ilii, and sufficiently low to leave the upper end of the gluteal cleft visible; the latter is especially important in stout adult patients, as a guide to the middle line. The patient stands exactly in front of the surgeon with the back to him, the feet together and symmetrically placed, and the knees kept fully extended. The gluteal cleft is placed exactly in the middle line as compared with the feet and legs; in this way, any rotation of the pelvis, on its transverse axis, is corrected. With these exceptions, the patient is to stand in her habitual or most comfortable position.

In the case taken, there is decided irregularity in the lateral outlines of the trunk, the right side being too much hollowed, with undue prominence of the right iliac crest, while the left iliac crest is not visible as a prominence at all. The lower angle of the right scapula is rather higher and more prominent than that of the left. The posterior spinous process of each vertebra, beginning at the seventh cervical, and ending at the top of the sacrum, should now be carefully marked, and for this purpose one of the popular copying pencils, such as the soft 'automatic eagle,' is best, as the perspiration of the patient's skin facilitates the marking. Any special tenderness of one or more vertebræ will be at once recognised during the marking. This local hyperæsthesia is often present in lateral curvature, and does not indicate spinal caries in any way. The dorsal or upper lateral curvature with convexity to the right, and lower or lumbar lateral curvature with convexity to the left, are much more readily recognised after the marking. The right side, below the scapula, is decidedly fuller than the left. It should be noticed whether the two iliac crests are really on the same level, and this is done by the surgeon carefully and firmly pressing a forefinger of each hand into the soft tissues above each iliac bone; any apparent difference in level will disappear at once if the lower limbs are of equal length.

In the common form of lateral curvature, with dorsal convexity to the right, and lumbar convexity to the left, the *right* iliac crest is generally too prominent, as just stated. This increased prominence of the right iliac crest is produced by the lumbar lateral curvature carrying the trunk, immediately above the sacrum, at first to the left till the centre of the convexity is reached. The soft tissues, above the right iliac crest, are thus carried over towards the left, and if there is much subcutaneous fat, this often makes the right iliac crest appear too high, as if the pelvis were tilted transversely. The prominence of the left iliac crest at the same time becomes less than usual, or is lost altogether, because the skin, fat, &c., are carried more over it than usual. Sometimes, however, the *left* iliac crest appears too prominent, even in cases of ordinary lateral curvature with dorsal convexity to the right, when the dorsal curvature implicates a larger number of vertebræ than usual, while the lumbar lateral curvature is but slight. In these cases, the lower half of the dorsal curvature carries the whole trunk over to the right, leaving the left iliac crest uncovered, and hence apparently too high.

If there is any doubt about the lengths of the legs being equal, accurate measurements must be taken before the conclusion of the examination. Allowing the petticoats to slip below the gluteal folds will often settle the point; for if the buttocks are perfectly symmetrical, there cannot be much, if any, difference. A practical method of ascertaining this at once, and one which does not entail any further undressing than the baring of the knees, is to make the patient lie on the ground, perfectly straight on her back, with the hips and knees fully flexed, and the feet placed symmetrically close together on the ground, with the knees touching each other. The slightest difference in length, of the two lower extremities, will be indicated either by a higher level or by a greater projection forwards of one knee. If such difference be present, the ordinary measurements, between the antero-superior iliac spinous process and the internal malleolus are to be taken, to obtain the actual amount of shortening.

To return to the examination of the trunk; the patient, still in her natural or habitual position, but with the knees straight and the feet close together, is now looked at *sideways*; a considerable exaggeration of the usual cervico-dorsal antero-posterior curve is generally observed; the middle dorsal vertebræ may, in some cases, have their posterior spinous processes projecting backwards beyond the vertical plane of the sacrum. At the same time the abdomen is too prominent, even when the patient is emaciated, and the thorax anteriorly is flattened, frequently with much hollowing of the infra-mammary regions. The head pokes, and the neck is directed forwards in front of, instead of being at the top of, the trunk. The patient should now be inspected *anteriorly* in the same position as before; generally the two lateral halves of the trunk appear more unsymmetrical than from behind; the mammæ, if at all developed, will exaggerate any deformity of the surfaces on which they lie. In the usual form of lateral curvature, with upper dorsal convexity to the right, the left mamma is generally more prominent, and considerably lower than the right; this undue prominence of the left mamma is due to the greater convexity of the left ribs anteriorly. The right iliac crest will also appear more prominent than when seen from behind.

The patient should now be again examined from behind, and, while the knees are kept well extended, requested to flex the trunk fully forwards, the arms hanging loosely downwards. In the case described, the left erector spinæ muscle, between the iliac crest and the last rib, is considerably broader and more prominent as compared with the corresponding right muscle, which was unduly depressed; the lumbar lateral curve being convex to the left, the left transverse processes of the lumbar vertebræ have been rotated backwards, raising up the large mass of the erector spinæ muscle, while the right transverse processes are rotated forwards, causing the overlying muscle to be less prominent than usual. In this flexed position of the trunk, the ribs posteriorly are left uncovered by the elevation and falling forwards of the scapulæ; the right ribs have their posterior angles and adjacent portions too convex, and on a higher level than the corresponding left ribs. This is due to exactly the same cause as the want of symmetry of the erectores spinæ muscles; the dorsal curvature being convex to the right, the right transverse processes of the dorsal vertebræ, with the ribs attached, have been rotated backwards, while the left transverse processes and corresponding ribs have been rotated forwards. The whole prognosis, as will be seen later, depends upon the greater or lesser want of symmetry of the two lateral halves of the trunk, examined thus while the spine is flexed.

To obtain an accurate record, for future reference, of the want of symmetry of the patient's back, the writer employs a malleable strip of lead applied *transversely* to the ribs posteriorly, and extending from the lower angle of the right scapula to the corresponding portion of the left scapula, while the patient's spine is well flexed with the arms hanging feebly down; from this a tracing can be readily taken on a sheet of paper. Another transverse tracing can then be made of the loins opposite the third lumbar spine, and extending on each side to where the muscular walls of the abdomen commence. In each tracing the position of the spine should be carefully marked.

The patient should next be directed to place herself in what she considers the most erect position; if there is any curvature, she will only aggravate the deformity by throwing the trunk too far backwards, by unequally raising the scapulæ, and putting the head to one side, or by assuming some equally unnatural position. The surgeon should now place the patient in the *best possible position*; in slight cases, where there is very little or no osseous deformity, he will succeed in obtaining a perfectly normal posture with the scapulæ and iliac crests symmetrical, the thorax well thrown out, the abdomen withdrawn from undue prominence, and the head erect. The patient should be observed in this improved position, not only posteriorly, but also laterally and anteriorly. The patient is only able to maintain this position by a great effort for a few seconds, and she will feel as if she were more crooked than before. The muscular sense has become so perverted, that the habitual crooked position appears to her to be far more natural and straighter than the really erect or improved posture; the latter gives her, at first, the impression of an exaggeration of the deformity. In severer cases, it is necessary to ascertain the position of the arms which gives the best average improvement of the whole spine and trunk, e.g. the right arm directed upwards, the left outwards at right angles to the trunk, is a position which, in a large number of cases, effects this improvement, and to this the writer refers as the '*key-note*' position while describing the treatment. It is advisable, before concluding the examination, to let the patient stand erect with her back against the door, heels, sacrum, dorsum and occiput touching it, and with the shoulders well thrown back. While in this position, her mother or friend should try to fasten the stays and clothes in front. In most cases these will not meet for one or more inches, such great alteration and enlargement of the thorax anteriorly being effected by this simple device. This applies not only to females, but also to males, the waistcoat, coat, and overcoat, and frequently even the shirt collar, not meeting for an inch or more when the patient is placed thus with his back against the door. Finally, the stockings being removed, notice should be taken whether the patient is flat-footed or not. One out of every three cases of lateral spinal curvature has marked flat-foot (*see* FLAT-FOOT).

The *prognosis* depends altogether on the presence or absence of permanent osseous deformity of the ribs and vertebral column. If there is no osseous deformity found when the patient's trunk is flexed, it is possible in all cases to restore the patient's figure to the normal, and to prognosticate a more or less complete cure; the only exception being where the curvature is due to paralysis of the spinal muscles, when the prognosis is doubtful and difficult. Again, patients with deficient intellect, or who take no interest in their treatment, are difficult to benefit, and the prognosis is unfavourable.

Any case of 'confirmed' lateral curvature, i.e. where the patient has lost the muscular sense of a really straight position of the spine, and where his unaided attempts to rectify the deformity only tend instead to increase it, if left untreated is bound to become worse during a series of either months or years; some cases become much more rapidly worse than others. The popular and prevalent opinion that 'the patient will grow out of it in time,' without any special treatment being employed, is to be combated; cases of lateral curvature of the spine, which might have been thoroughly cured when first observed, are hence often neglected till too late, when a cure, i.e. complete restoration of form as well as of function, is out of the question.

Lateral curvature without any osseous deformity can, generally, be practically cured by one month's daily treatment; but strict attention to position, and perseverance with prescribed exercises for about a year afterwards, are needful to prevent relapse.

Where there is more or less permanent osseous deformity, the amount of improvement possible can be roughly judged of at the first examination. As a rule, the patient can be sufficiently strengthened, and the muscular sense thoroughly re-educated so that the best possible position becomes an habitual one, by three months' daily treatment.

The presence of much *pain* may sometimes prolong the time required; but, even in these cases, one month's daily treatment generally effects a decided improvement, with more or less relief to the pain; and three months' a complete disappearance of the pain, and a greatly improved figure, i.e. the best possible habitual posture which the osseous deformity admits of.

In cases of extreme osseous deformity, the steel or other spinal support, if worn even for years, should be discontinued at once; and if the treatment advised below is followed, complete, or almost complete, relief from pain, and a greater or less improvement in the figure and straightness of the spine will be obtained in three months; but the actual osseous deformity of the ribs and vertebræ cannot be much, if at all, altered.

Treatment.— Common sense suggests that any inequality, in the potential or actual lengths of the lower extremities, is to be corrected by wearing a thicker sole on the shorter leg, whatever other treatment may appear to be indicated.

Of late years, the implicit faith formerly placed in the treatment of lateral curvature of the spine by steel and other supports has been gradually undermined, and even those who still adhere to the mechanical treatment of spinal deformities not due to caries, attach more and more importance to its association with suitably prescribed gymnastics. Lateral spinal curvatures, due to paralysis of the erectores spinæ muscles, when the patient is unable, by a voluntary effort, to maintain himself in an improved position, are the only cases in which spinal supports are of any real benefit. In these paralysed backs, it is necessary to prevent further increase of deformity by wearing some sort of spinal support; either the ordinary steel one with pelvic band and uprights, with or without crutches to fit into the axillæ; or, which is far better, a well-applied Sayre's plaster-jacket, which should be worn till the muscles have sufficiently recovered from their paralysis to enable the patient to hold the spine in an improved position. It is understood that the support is worn with the sole idea of being preventive, and not of being curative, and should be left off at night in bed.

Lying on the back for several hours daily, still frequently prescribed, is perfectly useless, as far as cure is concerned. If a limb with weak muscles were put into splints, and kept at rest for several hours daily, the muscles would surely become still weaker; and this is equally true of the spinal muscles. The patient may rest prone or supine for fifteen or thirty minutes at a time, for the relief of pain or when fatigued by exercise, but lying for longer periods does more harm than good.

The *treatment* advocated by the writer is based upon the following principles, and may be taken under the following heads:—

(*a*) Re-education of the patient's muscular sense as to an erect or improved position.

(*b*) Improved position to be maintained at all times, while sitting or standing.

(*c*) Attention to dress.

(*d*) Systematic training of the spinal and other muscles, including the development of the thorax.

(*e*) Attention to general health.

a. Re-education of the patient's muscular sense as to an erect or improved position.—A patient, with confirmed lateral spinal curvature, is so habituated to the crooked position, that considerable patience and perseverance are required to convince him or her that an erect or improved posture is really such, and not an exaggeration of the deformity. The best way of commencing this re-education is for the patient to lie on the back in the best possible position, and then to practise slow breathing, the shoulders being kept well pressed back, and prevented from rising by the patient trying to push the hands down towards the feet as much as possible. All the simple movements of the head (neck), arms, and legs can be practised in this position. A hand looking-glass, as well as an ordinary wall-mirror, is required, so that the patient may see and be convinced of the improved position.

As a home prescription, it is useful to direct the patient to stand frequently (e.g. before and after each meal), in front of a looking-glass, with the eyes closed until she believes she has placed herself in an erect position; generally, on first attempting this experiment, she opens her eyes to find that the head is inclined to one side or one shoulder unduly raised. Usually by the end of a week, and, in very persevering and intelligent patients, even at the end of two or three days, the muscular sense is sufficiently improved to enable the patient to place herself at once in a decidedly improved posture by a voluntary effort at any moment, whether lying, sitting, standing, or walking.

b. Improved position to be maintained at all times, while sitting or standing.—This best possible posture is always to be maintained while sitting, whatever the occupation of the moment may be, at meals, at the piano, while reading, writing, &c. It is most readily obtained by sitting with the sacrum, loins, dorsum, and shoulders well supported against the back of the chair, which should be moulded to the normal shape of the spine, with a slight prominence to fill the lumbar hollow. Almost any ordinary chair can be made to answer the purpose, if a suitable cushion is used. In writing, the patient's trunk is required to be more vertical than for reading, and it is essential that not only the trunk but the arms should remain perfectly symmetrical. A sloping desk is absolutely required, and the paper should be oblique, sloping upwards from right to left, but exactly in front of the patient. The Glendinning adjustable modern school-desk and seat, manufactured by the North of England School Furnishing Company, Darlington, will be found most beneficial for patients of school age, and even for adults. In reading, an inclined back to the chair is more restful to the patient, and an easel-table should support the book. For music the same rules apply, the ordinary music-stool being discarded and a high-backed chair employed, which will also come in useful for meals. In all cases, the seat of the chair or couch should be horizontal, and not tilted up in front, as is frequently seen in so-called spinal couches, and the patients feet should always be supported either by the ground or by a footstool. The thighs should never be crossed, as this throws the spine as much on one side as standing on one leg does.

Short-sight, or any other deficiency of the eyes, must be at once attended to, by suitable spectacles, &c., as it would be useless to urge a patient to hold himself erect who had always to poke the head forward for reading or looking at any object.

The patient may walk, run, and join in games, even lawn-tennis, if sufficiently strong, provided any fatigue thus induced disappears after resting for a quarter or half an hour; any walk or exercise that induces fatigue or pain lasting hours, only does harm. In such cases the duration of the walk, &c., must be curtailed. Standing still should be avoided at all times; when inevitable, the patient should stand equally on both legs, with the feet slightly apart. Standing on one leg is most injurious, as it at once throws the spine into a serpentine position, increasing the lateral curvature.

A horsehair mattress with a low pillow for the head, is all that can be advised for the night.

c. Attention to Dress.—It is essential that no article of clothing should interfere with the resumption of an improved or perfectly normal position of the patients' spine and trunk. This can be tested by making the patient stand with the back to the wall and with the clothes opened in front, as already mentioned (see *Mode of Examination*). In women, there should be no red zone of pressure on the skin of the thorax or abdomen produced by stays or injudiciously placed petticoat-bands; the latter should be shaped and made to fit round the pelvis, so as not to compress the lower ribs above the iliac crests. Stays with very little whalebone or steel, and with a vertical slip of elastic webbing, expanding transversely, inserted on each side, are strongly advised. Such stays admit of the full expansion of the lower ribs.

d. Systematic training of the spinal and other muscles, including the development of the thorax.—At first, attention is to be directed to correcting the antero-posterior curves of the spine; when these are improved, then only is it possible to carry out special exercises for correcting the dorsal and lumbar lateral curves.

The following is a prescription of twelve exercises which are recommended to be used at the commencement of the treatment of all cases of lateral curvature of the spine. The patient should rest for a minute or two between each exercise, on a couch with movable back fixed at an angle of 45°, or an ordinary chair if properly arranged.

First prescription of exercises.

1. Lying on back, arms by the sides of the body, hands supinated, slow full inspiration by the nose; slow expiration by the mouth (repeated four times).
2. Similar exercise with the arms extended upwards by the sides of the head (repeat four times).
3. Same position as 1, head-rotation on axis to right and left alternately; also lateral flexion of head to right and left alternately (four times).
4. Lying on back, slow simultaneous circumduction of both shoulder-joints from before backwards, elbows and wrists extended (twelve times).
5. Same position as 1; hip-circumduction both ways slowly; knees kept extended (ten times).
6. Lying on back, simultaneous extension of arms upwards, outwards, and downwards from a position with the elbows flexed and close to the trunk (four times).
7. Lying prone; hip-circumduction both ways; knee kept extended (ten times).
8. Sitting on couch with back at an angle of 45°: ankle-circumduction down, in, up, out, the toes being directed inwards the whole time (twenty times); also foot adduction (patient resisting); abduction (surgeon resisting), (eight times). [This may be omitted if there is no tendency to flat-foot.]
9. Lying on back, arms extended upwards by the sides of the head; slow flexion of both arms (surgeon resisting by grasping the hands), followed by extension (patient resisting), (six to eight times). The patient's knees, flexed over the end of the couch or table, fix the trunk.
10. Patient sitting astride a narrow table or chair without back, with arms down and hands supinated, trunk-flexion at the lumbar vertebræ (patient resisting slightly), followed by trunk-extension (surgeon resisting by his hand against back of patient's head), (six to ten times).
11. Patient with arms extended upwards, leans against a vertical post or door fitted with pegs on each side, which he grasps; the surgeon gently pulls the patient's pelvis forwards by his hands on the

sacrum (patient resisting), and the patient then moves back the pelvis to the post or door (surgeon resisting), (six to eight times). At no time are the patient's heels to be raised from the floor. Also pelvis-rotation on its axis to right and left alternately (surgeon resisting with his hands on each side of the pelvis), (six to eight times).

12. Lying on back with head and neck projecting beyond the end of the table, arms by the sides of the body, hands supinated; the head is gently flexed by the surgeon's hand on the occiput (patient resisting), followed by head-extension (surgeon resisting), (eight times).

It is important, while doing these exercises, that respiration should not be interfered with by involuntary fixation of the walls of the thorax. The patient should therefore always go on counting aloud (e.g. 1 to 10) during the execution of all exercises except those of respiration. From six to twelve longitudinal 'strokings' from above down of the patient's back by the assistant's palms, generally remove any aching caused by the exercises. These strokings are also usefully employed at home to relieve back-ache. All the exercises should be done slowly, and great care taken that the head and trunk remain the whole time in the best position. The above twelve exercises require about an hour's time, and should be followed by a short rest in a good position, with the back supported. In ordinary general practice, an intelligent mother or nurse can be readily trained to superintend all the simple movements.

These exercises are repeated daily, and as the patient gradually gains more power, and begins to assume the improved position more readily and with less exertion, other more severe exercises may be prescribed. In a few days, if there is no increase of back-ache, the following *standing* exercise is done; the patient, with the feet slightly apart and the heels fixed against a ledge or wall, rests with the front of the thighs against a low padded horizontal bar, while holding herself as erect as possible; the surgeon then gently flexes the patient's trunk by pressing his hand against the back of her head (patient resisting), and then the patient slowly recovers the vertical position against the surgeon's resistance, this being in fact exercise 10, in a standing instead of a sitting posture.

In about three weeks or a month, the following much more severe exercise can be tried, known as '*Forwards lying, heels fixed, trunk extension and flexion.*' This is done as follows:—the patient lies prone, with the pelvis and legs supported, and the heels fixed (the latter best by someone sitting on them), on a padded table, while the head and trunk to the level of the iliac crests project beyond the edge of the table. The patient slowly raises the trunk into the same horizontal position as the legs and pelvis, and slightly higher, and then as slowly allows the trunk to be again flexed by its own weight. The surgeon easily increases the severity of the exercise, if required, by more or less pressure with one hand at the back of the patient's head. During this exercise, the arms may be in any position required. By the time the patient is able to perform this exercise without pain, the antero-posterior curves will be sufficiently improved, and more attention can be paid to her being exercised in the 'key-note' position, i.e. that position of the trunk and arms in which the greatest improvement in the position of the spine is obtained. (See *Mode of Examination.*)

Another good exercise is one shortly described as '*Long sitting, trunk extension and flexion.*' Here the patient sits on a table, with the legs together and the knees extended; an assistant sits on the tibiæ, just above the feet, to fix the legs, and the patient slowly extends the spine against the surgeon's resistance (applied by his hand against the back of the patient's head) till the trunk is in the same horizontal plane as the legs; the patient then gently resists, while the surgeon slowly raises her trunk into a vertical position.

Female patients continue the daily repetition of these exercises during the menses, except that the hip-circumductions are omitted for three or four days, as these movements tend to increase the menstrual flow. Where menorrhagia or dysmenorrhœa is present, it is sometimes necessary to leave off the exercises altogether for a day or two. As a general rule, it is better to accustom the patient to practise the exercises all through the period of menstruation. While on the subject, it may be stated that flexions of the uterus are no hindrance to the treatment, as none of the exercises described are violent or jerky in their execution, and from the fact that respiration is never allowed to be impeded by the previously mentioned simple device of making the patient constantly count aloud, any over-exertion can always be prevented with ordinary care.

The patient's spine should be examined every fortnight or month in order to observe how it is affected by the treatment, and whether any alteration of details is required. As already mentioned, one month's daily perseverance in the treatment will effect a very decided improvement in all cases, except those due to paralysis; some with no osseous deformity will even be quite cured, and others at the end of two months. To keep up the improvement, or to prevent any relapse in a cured case, it is very important to enlist the patient's co-operation and interest in her own case on ceasing treatment, and for some months she should continue the habit of practising the movements already described.

Bernard Roth.

LEECH, Artificial, an ingenious contrivance, obtainable at any surgical instrument maker's, consisting of two parts—1st, *the knife*, arranged in the form of a small rotating trephine, with a cutting edge which projects from a flat surface and can be adjusted at any depth thought sufficient to cut through the *cutis vera* only; 2nd, *the sucker*, a hollow glass cylinder, about three-quarters of an inch in diameter, fitted with a piston worked by a fine screw.

The part having been sponged with warm water, an incision is made with the knife, the open end of the sucker placed firmly over the wound, and the blood extracted by slowly withdrawing the piston. Two or three drachms can readily be taken by this process, which is, in fact, merely a modification of wet cupping. *See* Cupping.

The method is of use when a leech is objected to by an over-sensitive patient, and is particularly suited for application to the temple or behind the ear.

William H. Bennett.

LEECHES.—Leeching is a convenient method of *local blood-letting*, in which an approximate idea of the amount of blood taken can be formed. It is applicable to any part of the external surface of the body (with the exception of the eyelids), and to any mucous cavity which is freely accessible from without, such as the mouth, the vagina, and the margins of the os uteri. Leeches should not be applied to acutely inflamed skin, to the anus if extensive piles exist, nor immediately over varicose veins. An ordinary fresh leech will abstract about f℥ij. of blood, which may be increased by about half by fomenting or poulticing the bite.

Leeches should be taken from the water in which they have been kept, and dried on a soft towel, about half an hour before use. It is desirable that a leech should be used once only.

Method of Application.—When the external surface of the body is to be operated on, the part should, if necessary, be shaved and then sponged with warm water, or, what is better, rubbed over with milk. If a single leech is to be applied, it may be taken between the finger and thumb and held with its *small end* in contact with the part until it attaches itself. A preferable plan, however, especially if it is necessary that the bite should be exactly localised, is to place the leech in a leech-glass or roll of cardboard, either of which may be made to accurately determine the point of fixation. If more than one is to be used, the simplest plan is to place two, three, or more leeches in a large pill-box or small teacup, which is then inverted and held on the part; other devices of a similar kind may suggest themselves—e.g. a folded handkerchief, a cone of cardboard, or a nest of cotton-wool.

The application of a leech inside a cavity should be effected by means of a 'leech-glass,' the part having been exposed to view as freely as possible; for instance, in the case of the os uteri, a vaginal speculum should be passed and retained *in situ* until the leech has relaxed its hold. In leeching the immediate vicinity of the orifice of any canal, it is a wise precaution to plug the opening, when possible, with cotton-wool.

In the event of an obstinate refusal to bite, a drop of blood drawn by the prick of a needle will afford an irresistible bait. When fully distended, the leech usually relaxes its hold and falls off; if it does not, a little salt sprinkled over it will effect the separation. The bleeding from the bites as a rule ceases upon exposure to the air, or can be stopped by the pressure of a finger or pad of lint; should it persist, a drop of perchloride of iron or the touch of a red-hot needle is sufficient, excepting in very rare cases, when it may be necessary to encircle the bite with a ligature tied beneath a needle, which has been passed under its base.

In delicate persons, in whom a leech often creates great disgust, if one only is necessary, an efficient substitute will be found in the artificial leech, *see* Leech, Artificial. The scar of a leech-bite, although small, is indelible.

William H. Bennett.

LEG, Amputations of the, are performed in its lower, middle, and upper thirds by the following methods :—

In the Lower Third by (*a*) the circular method; (*b*) modified circular (Syme, Liston, Lenoir); (*c*) long anterior flap (Bell, Teale); (*d*) elliptic posterior flap (Guyon).

In the Middle Third by (*a*) long anterior curved flap (Bell); (*b*) Hey's amputation by short anterior and long posterior flap; (*c*) rectangular (Teale); (*d*) long posterior rectangular (Lee); (*e*) single posterior flap.

In the Upper Third at 'the place of election,' a hand's breadth below the lower edge of the patella, by (*a*) the circular method; (*b*) short anterior and long posterior flaps (Liston, Syme, Skey); (*c*) unilateral external flap (Sedillot, Guérin); (*d*) rectangular (Teale); (*e*) modifications of rectangular (Wharton, Lee); (*f*) antero-external and postero-internal semilunar flaps (Bell); and (*g*) *above* the place of election, the circular amputation (Larrey), in which the tibia is divided through, but not above the tubercle, and the head of the fibula disarticulated. The alleged advantages of this last procedure are, its being easier than at the 'place of election' from the absence of an interosseous space, and only a single artery—the popliteal—requiring deligation; but the frequency of communication between the superior tibio-fibular articulation and the knee-joint is sufficient to render the operation one attended with considerable risk.

The situation best adapted to the *circular* method and its modifications is the lower third, in which, owing to the large number of tendons, the 'flap' methods are not as a rule indicated. In performing the circular amputation immediately above the ankle, difficulty, consequent on the increasing size of the limb, is sometimes experienced, in reflecting the flaps, and hence the modifications recommended by Lenoir and Syme. The former made, in addition to the circular, a vertical incision about an inch and a half in length, corresponding to the crest of the tibia, and dissected back the skin-flaps right and left. Syme, with the same object, made two lunated incisions, one anterior and the other posterior; but, at the 'place of election' and immediately above it, the circular method can be carried out without these modifications.

In the lower third some authorities consider Teale's *rectangular flap* operation to be indicated; but having regard to the thinness of the anterior flap, there is, in the writer's opinion, a danger of sloughing, although, doubtless, the risk is diminished by taking care to include the anterior tibial artery in the flap. To avoid wounding this vessel, it is recommended that the handle of the scalpel should be used in raising the vessels from the interosseous membrane; and, in operating high up in the leg, the surgeon must be careful not to cut the origin of the anterior tibial artery when dissecting the short flap. Half the circumference of the limb at the point where the bone is divided will be the length and the breadth of the anterior flap; the breadth of the posterior flap will be the same as that of the anterior, and its length one-fourth of that flap. Having divided the integumentary structures at the outset, to allow for contraction, the deeper incisions are made, following closely the line of the contracted integument, and the danger of muscular protrusion is in this way avoided. To obviate the risk already mentioned—namely of sloughing —care must be observed in dissecting up the anterior flap to include the anterior tibial artery. The posterior flap is formed by a circular sweep of the knife, and is dissected back to a point corresponding to the situation of the osseous section. The rest of the operation is performed as already described. The inferior angles of both flaps should first be united, and then their remaining edges brought into accurate apposition with numerous points of interrupted suture. The advantages of this method are that the cicatrix is drawn well behind the point of pressure, the wound is dependent, so that in the event of matter forming, it gravitates through it; the principal vessels and nerves in the posterior flap are removed from pressure, the flap affords ample covering for the bones, and the risk of conical or sugar-loaf stump is greatly diminished.

The other *flap* operations are done at the place of election and at the middle third. For amputation at the middle of the leg Hey's method, which has not, in the writer's opinion, received sufficient recognition, is, of the 'flap' methods, decidedly the best. It consists in obtaining a short but broad anterior flap and a long posterior one. The circumference of the limb being taken, two-thirds of it will be the breadth, and one inch the length of the anterior flap, while one-third will be the breadth and one-third the length of the posterior. Hey divided the posterior flap by transfixion with a catlin seven inches in length, and separated the integuments in the anterior part of the limb along the course of the circular incision. In this procedure, the desirability of dividing the interosseous structures at least half an inch below the point of section of the bone, so that the arteries may not retract beyond reach, should not be forgotten.

Liston's operation is done at the place of election, and consists in a short anterior and a long posterior flap taken from the calf of the leg. Having determined the position of the fibula, to avoid the danger of passing the knife between the bones, the surgeon, standing to the right of the limb, which is elevated by an assistant, places his left index finger on the inner edge of the tibia and his thumb on the posterior edge of the fibula. Then, taking a long catlin and placing its heel immediately in front of the index finger, he makes a semilunar sweep across the front of the leg between the selected points—namely, the inner edge of the tibia and the posterior margin of the fibula—penetrating the posterior tissues of the leg, and transfixing it close behind the fibula, and cutting from behind forwards a posterior flap somewhat longer than the anterior. The anterior flap, consisting mainly of integument and fat, is dissected back, and, the interosseous structures being divided, the saw is applied to the tibia. When the bone has been sawn to at least half its thickness, the handle of the saw should be depressed, to bring the instrument into contact with the fibula, and then both bones are simultaneously divided. The sharp projecting angle of the tibia is removed either by a small oblique section with the saw, or by dividing it with a pair of bone-forceps. The tibial, peroneal, interosseous, and muscular arteries having been secured, the edges of the flap are brought together by numerous points of interrupted suture and the wound is dressed antiseptically.

In estimating the comparative value of the various methods of amputation of the leg in each of the three situations already indicated—viz. the lower, middle, and upper third —the writer is disposed to consider that in the first the 'circular,' or the modifications of it which have been mentioned, notably that of Prof. Syme, will be found most suitable; in the second, the antero-posterior flap methods of Teale or that of Hey must be considered preferable; and in the last situation, or upper third, the amputation by short anterior and long posterior flaps—Liston's or Skey's modification of it, which consists in diminishing the thickness of the posterior flap by not including the tissues in their entirety in it—will give the best results. William Stokes.

LEG, Diagnosis of Affections of the. *See* Thigh and Leg, Diagnosis of Affections of.

LEG, Fractures of the, include fractures of the two bones together or of either the tibia or the fibula alone. Of these injuries fracture of both bones is the most frequent, while fracture of the fibula is more frequent than fracture of the tibia; the relative numbers stated approximately being of both bones eight, of the fibula alone five, of the tibia alone three. Probably, in many cases regarded as fracture of the tibia only, undetected fracture of the fibula has also been present. In infancy fracture of the leg is very rare, while fracture of the thigh is of comparatively frequent occurrence. The explanation probably is that young children, who have learnt to walk only imperfectly, fall with the limbs drawn up so that the force comes chiefly on the femur rather than on the bones of the leg.

Fracture of the Tibia most commonly occurs in the lower third, where the bone is smallest. The injury is often caused by indirect violence, such as a fall on the feet, or a sudden wrench of the leg when the foot is fixed; or it may be produced by direct violence—a kick, a blow, the passage of a wheel, &c., in which case any part of the shaft, even its more massive upper end, may be broken. The fracture is generally oblique; most frequently perhaps from above downwards and from without inwards. It may, however, take any other direction. When due to direct violence it is often transverse. Sometimes, the bone is extensively split in a longitudinal direction, the fracture extending into either the knee or the ankle-joint. Owing to the fact that the bone lies so close beneath the surface, and that the break is oblique, so that the upper fragment presents a sharp end, the fracture is frequently either compound at the time, or is rendered so by subsequent movement. Great care should be used to avoid this occurrence during the lifting or undressing of the patient. In falls upon the heel, from a height of even not more than two or three feet, the tibia is sometimes much comminuted and the ankle-joint extensively involved; in other instances, although the fibula remains entire, there is great deformity from displacement of the foot.

Diagnosis.—Fracture of the tibia generally declares itself by displacement, irregularity of the outline of the bone, shortening, mobility of the fragments, and crepitus. In children, and in cases in which the fracture is unattended with displacement, the nature of the injury may very easily be overlooked, especially as the patient can sometimes bear considerable weight upon the limb. In cases of doubt, the bone should be grasped above and below the part at which it is painful or tender on firm pressure, and attempts, but with no undue violence, should be made to move one part on another, first in a transverse and then in an antero-posterior direction, when, if there is fracture, yielding and crepitus will be detected. The knee-joint may be involved either by longitudinal splitting of the shaft, or by separation of one of the tuberosities. A mere fissure of the bone will probably escape notice; but fracture through the tuberosities will be indicated by widening of the head of the bone, irregularity, and crepitus. The joint, in either case, becomes distended with blood and serous effusion, and acute synovitis is often present. After this injury, movement of the joint may be more or less impaired, especially where the fragments cannot be accurately adjusted; or when acute synovitis with much plastic effusion has occurred.

Treatment is the same as that prescribed below for fracture of both *Tibia and Fibula*. When the knee-joint is involved, synovitis must be controlled by the use of ice or cold lotions, and by the maintenance of complete rest; it usually soon subsides. If distension is extreme the joint may be aspirated; but this proceeding is not without risk, and as a rule had better not be resorted to.

Fibula.—This bone may be fractured in any part of its length, but the great majority of the cases involve the inferior third of the shaft, within four or five inches of the tip of the malleolus. The injury may result from direct violence, but it is much more commonly produced by falls in which the foot is twisted upon the leg, sometimes with inversion, but more often with eversion.

Fractures of the shaft may take any direction, and may be multiple or comminuted; they are rarely compound. Fracture through the malleolus, due to sudden inversion of the foot, is generally transverse. In Pott's fracture, the fibula is broken from two to five inches above its lower end, the foot is dislocated outwards, and either the internal malleolus is wholly or in part torn off, or the internal lateral ligament is ruptured. When the fibula alone is broken, displacement of the fragments is usually slight. Cases are on record in which, either by direct violence or by the action of the biceps, the head of the fibula has been detached and the peroneal nerve injured, so that the anterior muscles of the limb below have remained paralysed.

Diagnosis.—The detection of fracture of the fibula is often very difficult, especially in a stout limb, and no doubt many cases are regarded as merely severe sprains. The best method of examination is to make firm pressure with the tips of the fingers along the course of the bone, when sharp pain will be produced as the site of the fracture is reached; and at the same time crepitus or a sharp click may perhaps be noticed. Or, when the fingers are placed on the lower end of the bone, an inch or two above the malleolus, and firm pressure is made upon the shaft higher up, if the bone is entire it may be felt to yield and recoil like a spring, while, if fracture is present, this transmitted movement and elastic recoil will not be observed.

Treatment.—When there is no displacement, the limb may be kept at rest on a pillow and be covered with cold lotion till swelling has subsided, and may then be enclosed in a light case of plaster of Paris or in carefully moulded leather or other splints. At the end of a month the apparatus may be removed, and the patient may begin to use the limb.

In Pott's fracture, or whenever there has been marked deformity at the time of the injury, great care must be taken to correct the displacement, and the limb should be placed in the apparatus recommended for fracture of both bones; or Dupuytren's inside splint may be employed. At the end of a month a plaster case may be applied, so that the patient may be on crutches, but he should not bear on the limb for another fortnight or three weeks. If weight is thrown upon the part earlier than the sixth or seventh week, the torn structures on the inside of the foot are apt to yield, so that aggravated valgus, very difficult to correct, is gradually developed. Another method of treatment is that by the immediate application of plaster of Paris.

Tibia and Fibula.—Fracture of both bones is produced, in almost equal proportions, by direct violence, as by a kick or the passage of a heavy wheel, and indirectly, as in jumps from a height, or by falls in which the leg is suddenly bent. Sometimes a fracture, which may be extensively comminuted, is produced merely by a slip off a step not more than a foot from the ground, or even off the kerb-stone. Fracture of both bones is most common at about the junction of the middle and the inferior thirds of the leg, where the tibia is smallest. It is rare and generally produced only by great direct violence, in the upper third, where the tibia is large and massive. In a few instances, fracture seems to have resulted from muscular action. The two bones may be broken at the same spot, but more commonly the fibula gives way at a higher level than the tibia. The fracture, though usually single, may be multiple or comminuted. Instances have been recorded, in which the tibia has been reduced to four distinct pieces by three lines of fracture. The fracture may extend either into the ankle or, more rarely, into the knee-joint. This complication is alluded to under *Tibia.* The direction of the fracture of the tibia, though sometimes transverse, is generally oblique from above downwards, and either inwards or with an inclination forwards; so that, even where the injury is not at first compound, the sharp end of the upper fragment is very apt to be driven through the skin during the subsequent movement and transference of the patient to bed—an occurrence which should be very carefully guarded against. The relative position of the fragments varies; but along with displacement of the lower fragment upwards, and generally outwards behind the upper, there is often also rotation of the lower fragment outwards by the weight of the foot.

A V-shaped or spiral fracture has been described by M. Gosselin. It is produced by rotation of the leg when the foot is fixed, so that the bones are subject to a violent twist or torsion movement. In this injury, the main fracture is in the shape of a V with its apex pointing downwards; while, from the receding angle presented by the lower fragment, another line of fracture passes in a spiral direction downwards into the ankle-joint, and, after traversing the articular surface of the tibia, ascends along the posterior aspect of the bone, so as to detach a considerable fragment from the lower part of the shaft. This spiral fracture is believed by Gosselin to be due to the wedge-like action of the upper upon the lower fragment, at the moment the bone is undergoing rotation. The injury deserves attention, not only because the ankle is involved, so that more or less stiffness of the joint may result, but because the extensive laceration of the medullary tissue which occurs may be followed, especially when the fracture is compound, by osteo-myelitis. This fracture is difficult of recognition, but the V-shaped outline of the fragments may suggest its presence, while careful examination shows that the ankle-joint is the seat of effusion, and the splintering of the lower end of the tibia may sometimes be made out.

Treatment.—This is best conducted by means of (*a*) a well-padded, iron, back splint extending three or four inches above the knee, curved to fit the limb, furnished with a rectangular foot-piece and with lateral bars for swinging the leg, and having an oval aperture at the lower end so that the heel may be free from pressure; and (*b*) straight side-splints. After the fragments have been adjusted, all shortening having been removed by extension, and care taken to place the ball of the great toe in a line with the inner edge of the patella, the foot is securely fastened to the foot-piece by wide strips of plaster and a bandage, a thin layer of cotton wool being used to protect the skin. Extension being continued, wide bands of strapping are placed spirally round the limb and splint above the level of the fracture, and covered with a bandage which should not be put on tightly. The side-splints are now applied to the inner and outer aspects of the leg from the sole to a little above the knee, and fastened with webbing straps and buckles; they should be a little deeper than the antero-posterior diameter of the limb, so as to project slightly beyond the anterior aspect of the tibia, in order that the webbing straps may stand clear of and not constrict the leg. The limb is then swung beneath a cradle, which should be large enough to prevent pressure of the bedclothes on the foot. This method is so comfortable, that it is advisable to use it even in the simplest cases so long as the patient is to remain in bed; while in complicated, and especially in compound, fractures—in the latter case the side-splints are interrupted opposite the injury—it is the best with which the writer is acquainted. The swinging of the limb enables the patient to change his position in bed without disturbing the fracture; all pressure over the seat of injury is avoided, and, as the seat of fracture is left uncovered, the position of the fragments can at any moment be observed. In the course of three to six weeks, in uncomplicated fractures, the limb may be enclosed in the ordinary plaster of Paris bandage, and the patient allowed to move about a little on crutches.

A plan that was formerly much in favour, and which may still be sometimes used with advantage if the fragments show a tendency to displacement when the leg is placed in the straight position, is to put the patient on the injured side, the leg being flexed on the thigh to relax the muscles and enclosed in lateral splints. It is advisable in all cases to put up the fracture as soon as possible in order to arrest muscular spasm and relieve pain; while the support to the tissues afforded by well-adapted bandages tends to limit effusion and swelling in the parts around the fracture. For a description of Mr. Croft's excellent method, *see* IMMOVABLE BANDAGES. The difficulty sometimes met with in fracture of the leg, of restoring the fragments to place, is best overcome by placing the patient under an anæsthetic and making extension when the leg is bent upon the thigh. Should this method fail, the tendo Achillis may be divided—a proceeding, however, which is seldom called for.

Compound fracture is more commonly met with in the leg than in any other part. The injury is generally the result of direct violence, though it is sometimes produced by falls upon the feet. The extent of the wound varies from a mere puncture of the skin by one of the fragments, or by some sharp body entering from without, to a wide rending open of all the soft parts down to the bone. In severe crushes, the amount of destruction of the soft parts is often out of all proportion to the size of the wound, all the muscles being reduced to a pulp. Sometimes the skin is stripped entirely off; in other cases, the tibial vessels or nerves are lacerated, or the injury extends into the ankle, or more rarely into the knee-joint. In compound fractures generally both bones are broken, though the tibia, or more rarely the fibula, alone may be involved.

Treatment.—By no other example could the improvements recently introduced in the treatment of wounds be more clearly shown, than by that of compound fracture of the leg. In a large proportion of cases, which would formerly have been treated by primary amputation, surgeons now venture on an attempt to save the limb, and the attempt is fully justified by the rarity with which secondary amputation is called for. Whether, in any case, primary amputation should be performed, can be determined only when all the circumstances that present themselves have been carefully considered, both singly and collectively. The following, however, are the main points: If the tibia is so extensively comminuted that, when the pieces which were entirely separated from the periosteum are removed, a very, considerable gap exists between the fragments, the limb would be useless, even if the soft parts should be repaired. Again, if both the tibial arteries are ruptured, and the limb is pulseless and cold, its condition is generally hopeless. But it must not be forgotten that, sometimes, pulsation is arrested by pressure of the fragments or by contusion of the internal and middle coats of the vessel; and therefore, unless bleeding is free, the mere loss of pulsation should not lead us to immediate amputation. Should the anterior tibial be found ruptured, while the posterior still beats, it should be tied; but when the posterior is bleeding persistently from a wound high in the limb, where it can be reached only by a tedious dissection, amputation had better be performed. In children, however, hæmorrhage may, as a rule, be safely dealt with by a well-applied compress. If either of the chief nerves is seen to be lacerated, its ends should be joined by suture. When the muscles are, as is often the case, crushed and minced, they are past restoration; but their mere rupture, or the separation of adjacent muscles by laceration of their sheaths, may be repaired. When the skin has been widely stripped off, especially if the separation extends around the whole girth of the leg, amputation is called for. The condition of the skin should always be carefully investigated. Often, though the wound itself is small, the integuments will be found to be separated over a considerable area.

In practice, the various injuries just alluded to will be met with in all degrees and in all varieties of combination. They must be carefully weighed; but we shall be justified in trusting largely to the means we now possess for turning the balance in the direction of an attempt to save the limb. HOWARD MARSH.

LEITER'S TUBES are made of flexible metal, with a fine bore through which hot or cold water may be made to circulate. The tubes are coiled up into spirals of various shapes and sizes, and the spirals are loosely connected with bands which allow of their being moulded to flat, hollow, or concave surfaces, and so form a metal surface which will rest evenly on the parts to which it is applied. They may be adapted evenly to the head in the form of a cap, to the throat, eye, chest, abdomen, joints, &c. One end of the tube is placed in a vessel containing water, hot or cold according to the requirements of the case, and the other dips into a receiver on the floor. If the supply vessel be raised and a little suction be applied to the terminal end of the tube, the water will be made to circulate through the coil and will continue to flow by syphon action. Before Leiter introduced metal tubes, coils of india-rubber tubing had been introduced by Richardson and Thornton; but they had certain disadvantages, which do not apply to Leiter's tubes. India-rubber is a bad conductor of heat, and so the water used had to be iced in order to produce the required reduction of temperature; the india-rubber tubes are soft and unsuitable for parts on which the patient rests, as his weight flattens the tubing and arrests the circulation of the water through it; india-rubber has a disagreeable smell. Leiter's tubes are free from all these objections. The metal is a good conductor of heat, and so the water used need not, and in fact should not, be iced; it does not collapse under the weight of the body, and it is free from smell. The tubes may be used for making warm applications at an even or gradually increasing or decreasing temperature, and Leiter has constructed a warming apparatus, through which the water is made to flow before it enters the coils of tubing. Bilton Pollard.

LEMBERT'S SUTURE is employed in closing wounds of the intestine. In such closure it is essential that the two serous surfaces about the wound should be brought in contact, and this is well effected by this particular suture. The needle is first made to pick up a little fold of peritoneum at a short distance (about 3 lines) from the edge of the wound. This fold would not be more than a line or so in width, being merely of sufficient size to afford a hold to the thread. In picking it up, the needle is passed at right angles to the long axis of the wound. A similar fold is now picked up at a corresponding point on the other side of the wound, and when the thread has been drawn through the two folds, and thus carried across the incision, the knot may be tied in the ordinary way. By this suture, the serous surfaces that immediately bound the margins of the wound are turned in towards the lumen of the gut, and are brought into close contact. The needle employed should be curved to the extent of half a circle, should be round on section, and of uniform thickness from the eye to within a short distance of the point. It must be held in a needle-holder.

Hagedorn's flat intestinal needle, and his ingenious needle-holder, are very well adapted for this form of suture. The best material for the ligature is, without doubt, the finest size of 'Chinese twist.'

Czerny-Lembert Suture.—By means of this suture for intestinal wounds much greater security is afforded. The sutures are applied in two rows. The first or inner row includes the mucous membrane only, and is applied in the form of a series of simple suture points. The second or outer row includes the peritoneum only, and is applied in the form of Lembert's suture. As, in wounds of the bowel, the mucous membrane, as a rule, projects conspicuously into the incision, the introduction of the first row of sutures is easy. It is almost needless to say that when the outer series of sutures is applied, the inner set is entirely covered in. Frederick Treves.

LENS. *See* Crystalline Lens.

LENTIGO (*Synon.* Ephelis, Freckles). An increase of the normal pigment of the epidermis in small spots varying from a pin's-head to a hemp-seed or more in size. Freckles are acquired in consequence of hereditary predisposition, and are rare before the age of six and after that of forty, disappearing completely in old age. They occur in persons of both sexes equally, and are met with chiefly, but not exclusively, in persons of fair complexion, especially those who have red hair. They appear chiefly on the face and backs of the hands, and are most strongly marked during the summer and after exposure to the sun; that they are not actually caused by the sun, however, is shown by their occurrence on parts of the body which are covered by clothing, as the buttocks, genitals, and abdomen. During the winter they become much less marked, but do not disappear completely. They consist of a circumscribed hypertrophy of the normal epidermic pigment. They are seen as rounded, oval, or irregularly polygonal spots, neither prominent nor depressed, of a dull yellow to orange or brownish tint. The larger spots (lentigo) have usually a rounded outline, while the smaller ones (ephelis) are more or less angular.

Freckles do not usually call for treatment; but, where they are so copious as to cause disfigurement to any serious extent, a weak lotion of corrosive sublimate may be recommended. John Cavafy.

LEONTIASIS OSSEA is a name given to a form of hyperostosis affecting the facial bones. The disease frequently commences in early life, and gradually encroaches upon the cavities of the skull and face, producing the most hideous deformity. It only very slowly causes the death of the victim, if by pressure it should interfere with any vital function. The osseous masses that are slowly developed about the superior maxillæ and orbits are formed of exceedingly hard compact bone, and are very irregular and nodular. They thus differ from osteoporosis, which has a more uniform outline and is composed of finely reticulated porous bone. They seem to be more of the nature of exostoses. In addition to this fact, the osteoporotic condition which is so well displayed in ostitis deformans does not, so far as we are at present able to judge from the records of cases, affect the bones of the face, but is entirely confined to the calvaria if the head shows any evidence of the disease. *See* JAWS, Diseases of the. H. H. CLUTTON.

LEPRA. *See* ELEPHANTIASIS GRÆCORUM.

LEPROSY. *See* ELEPHANTIASIS GRÆCORUM.

LEUCASMUS. *See* LEUCODERMA.

LEUCODERMA (*Synon.* Leucasmus, Leucopathia acquisita, Vitiligo).—An affection of the skin characterised by the appearance of white or nearly white patches, more or less symmetrically disposed, and due to loss of the normal epidermic pigment. The skin, in the immediate neighbourhood of the white patches, is usually pigmented in excess.

The causes of the affection are obscure; it is commonest in negroes and dark races generally, but not very infrequent in Europeans; it occurs in both sexes, perhaps most frequently in females, and chiefly between the ages of ten and thirty, though earlier and later instances are occasionally met with. A certain number of cases have been observed to follow acute febrile diseases (ague, typhoid fever, scarlatina); in others, pruritus, neuralgia, and various nervous affections and injuries have preceded the pigmentary change, which is most probably directly dependent on the nervous system, in some hitherto unexplained manner.

Pathological examination shows no other abnormality than deficiency or absence of the normal epidermic pigment in the white patches, and excess in the surrounding dark skin; there is, therefore, a simultaneous atrophy and hypertrophy of pigment; in some cases the hypertrophy is generally diffused, and precedes the atrophy by a considerable interval—that is, a diffused chloasma may gradually develop into leucoderma.

The symptoms of leucoderma are entirely limited to the appearance of white rounded or oval spots, neither raised nor depressed, having a convex border, and surrounded by a zone of hyperpigmented skin; they grow slowly, and by their coalescence give rise to large gyrate and irregular figures, the hyperpigmented skin being thus constantly invaded by the leucodermic patches, which ultimately predominate. The process may attack any part of the skin, but is usually most strongly marked over the trunk, especially the loins and abdomen, and the arms and thighs; the forearms and hands, legs and feet, and the face are commonly affected in a lesser degree. When the scalp is attacked, the hair of the affected part becomes white, and the same loss of pigment is found, as a rule, on hairy leucodermic parts of the skin (genitals, axilla); but occasionally the hair retains its colour. Sensation and secretion are perfectly normal. The process is very chronic, often lasting the whole of life; spontaneous improvement has been rarely noticed.

Diagnosis is not difficult. From true leprosy it may be distinguished by the history, the absence of anæsthesia and of other signs of leprosy, and by the sharp outline of the patches and normal texture of the skin; what is called 'white leprosy' in India is, doubtless, only severe leucoderma. Morphœa is followed by loss of pigment, but the affected parts are also generally atrophied and scar-like, and hence depressed beneath the level of the surrounding skin. From chloasma, leucoderma may be distinguished by the concave borders of the pigmented parts; they are convex in circumscribed chloasma.

Treatment is unsatisfactory. No internal remedy is of use, although arsenic has been suggested; locally, all that can be done is to promote removal of excess of pigment by weak lotions of corrosive sublimate, if this should be thought worth while. Any irritation of the white patches, as by mustard for example, may be followed by a return of pigmentation, but this is temporary and irregular, and does not influence the process in the least. JOHN CAVAFY.

LEUCOMA. *See* CORNEA, Ulceration of the.

LEVIS' APPARATUS for the reduction of dislocations of the fingers or thumb consists of a strip of wood, about ten inches long and one inch wide, which is perforated towards one extremity by six or eight holes arranged in two parallel series, and at the other is abruptly narrowed, so as to form a projecting peg around which the tapes completing the apparatus may be secured. The tapes, two in number, are passed through the holes at the end of the piece of wood in such a way that a loop arches across between a pair of holes. One loop should always project from the first pair, and the next may project from the second, third, or fourth pair of holes, according to the length of the digit for which the apparatus is required. To use it, the dislocated finger is placed on the splint and beneath the loops of tape; the loops are then tightened, and the ends of the tape carried along the under surface of the handle of the splint and firmly secured to the projecting peg. The advantages of this apparatus are that the finger is securely and rigidly fixed to a handle, by which extension and leverage can be brought to bear directly on the dislocated joint.

Bilton Pollard.

LICE. *See* Pediculi.

LICHEN.—There are five distinct diseases of the skin to which the name lichen is applied, but it cannot be said that these diseases form a satisfactory group, or that they have any close relationship to each other. They are—(1) lichen planus or ruber; (2) lichen circinatus; (3) lichen urticatus; (4) lichen scrofulosus; (5) lichen pilaris.

Lichen Planus or Ruber.—*Definition.*—An inflammatory disease of the skin characterised by an eruption of large, flat, shining papules of a purplish-red colour, which have a tendency to unite and form raised and scaly patches. The disease is attended with much itching and pigmentation, and with more or less constitutional disturbance.

Symptoms and Pathology.—A well-marked example of lichen planus has very characteristic features; some varieties of the disease are, however, met with in which these typical characters are wanting. The most important of these varieties has been called lichen ruber acuminatus, because the flat top of the papule is absent. In a typical example of lichen planus, the papules are considerably raised above the skin, and vary in size from a pin's head to a split pea; they are often quadrangular or polygonal in form; this is, however, by no means a constant feature, for in many instances they are well rounded. In the centre of each well-formed papule there is a slight depression or umbilication, which in some of the larger papules becomes a crater-like excavation, giving to the eruption a very peculiar and characteristic appearance. With the exception of the central depression, which is not always present, the surface of the papule is flat and glistening until a late stage of the disease, when the shining appearance is generally lost. The colour of the papules is a dull or purplish red, often standing out in marked contrast to the white skin around. In many instances the papules remain discrete throughout, but, in not a few cases, they coalesce so as to form raised and scaly patches closely resembling psoriasis. In very severe cases of this kind, nearly the whole body may be covered with raised scaly patches, and thus many of the distinctive features of the disease may be lost. Severe cases of this kind were first described by Hebra, and named by him lichen ruber; they differ from cases of lichen planus only in the greater extent of skin involved in the disease. Lichen planus is usually distributed symmetrically and most commonly on the flexor sides of the forearms, especially at the wrists; it is, however, seldom confined to that region. The course of the disease is most tedious, so much so that Hebra described the severer forms of the malady as incurable. The itching is usually very great, especially when the papules first appear; as the eruption fades it leaves behind dark pigmented stains, which often last long after the original papules have disappeared. On the whole it may be said that, with the exception of some forms of syphilis, lichen planus produces more pigmentation than any other disease of the skin. In severe types of the disease the constitutional disturbance is great, in which respect it presents a marked contrast to psoriasis.

Etiology.—The causes of lichen planus are quite unknown. It is very rare in young children, and is equally common in males and females. It is true that some observers have thought it more common in men, and others in women; the explanation of this is that they have not drawn their conclusions from a sufficient number of cases. The disease is comparatively rare.

Diagnosis.—There are only two diseases with which lichen planus can be confounded —viz. dermato-syphilis and psoriasis. In its discrete form it may be distinguished from any syphilitic eruption—(1) by the umbilicated form, peculiar colour, and arrangement of the papules; (2) the intense itching; (3) its distribution and symmetry; (4) the absence of any symptoms of syphilis; in short, the only point in which it closely resembles a syphilide is in the dark pigmentation produced. In the confluent form it certainly bears a close resemblance to psoriasis or a scaly syphilitic eruption; the great irritation and the history serve to distinguish it from the latter disease, while the out-lying papules, dark pigmentation, distribution, and constitutional disturbance help to distinguish it from the former.

Treatment. — Of internal remedies, arsenic and perchloride of mercury are the only two which have any distinct or definite value; of local remedies, weak alkaline baths are often very useful in relieving the intense itching. The baths may be followed up by sponging with liquor carbonis detergens lotion. A useful lotion of this kind is ℞ Liq. carbonis detergent. f℥ss., Glycerini, f℥ss., Liq. plumbi subacetatis dil. Oj. A nitrate of silver lotion (gr. iij. ad f℥j.) often relieves the irritation when the tar lotions fail. A perchloride of mercury lotion is also sometimes useful for the same purpose.

Lichen Circinatus is a fairly well defined though not very important affection of the skin. The eruption is met with chiefly on the chest and back, where it is apt to form a triangular patch, the base of which is directed upwards towards the shoulders and the apex towards the lumbar region. The eruption consists of minute reddish papules, some of which are discrete, while others are arranged in small rings or parts of circles; these rings spread centrifugally, leaving a central space of smooth slightly pigmented skin, the yellowish pigmentation giving the disease a superficial resemblance to pityriasis versicolor. Although the disease is most common on the chest and back, it is not strictly confined to those regions; it is attended with itching, which is not usually excessive. It is easily cured by the internal administration of arsenic and the local application of boracic acid or borax lotion.

Lichen Urticatus (*Synon.* Urticaria papulosa).—This disease has, in the opinion of the writer, more marked affinities with urticaria than with lichen; nevertheless, the large size and persistent character of the papules separate it very distinctly from ordinary urticaria. The older writers describe it as a mixed eruption of urticaria and lichen. The disease is met with almost entirely in children, and is very obstinate, usually lasting for several years, but with intervals of comparative subsidence; the itching and irritation are very great, especially at night, and this is always aggravated by the scratching of the patient, which can hardly be prevented. The disease is common amongst the poor, and not uncommon amongst the well-to-do classes in England. It is often mistaken by beginners for scabies, for the reason that in both the superficial characters are greatly due to scratching; for the same reason, the eruption set up in some children by pediculi and other insects may be easily mistaken for lichen urticatus. The difference, however, is soon evident, for, when the insects are removed the eruption disappears, and in this respect it differs, of course, entirely from true lichen urticatus, which is one of the most obstinate affections of the skin. The treatment of the disease consists—(1) in the removal of all local causes of irritation, such as flannel and stimulating soap; (2) in carefully regulating the diet, which should be of a highly nutritious but simple kind; (3) the administration of small doses of arsenic with alkalies and mild purgatives; (4) the local application of lotions and powders to relieve the itching.

Lichen Scrofulosus cannot be regarded as an important disease of the skin. It was first described by Hebra as almost exclusively met with in scrofulous people; it may, however, be fairly doubted whether he did not lay too much stress on this feature of the disease. The eruption has the following characters: (1) the papules are of a very pale colour, and about the size of small pins' heads; (2) they are arranged in patches more or less circular or ringed; (3) the eruption is most common on the trunk, less common on the limbs; (4) it is unattended with itching, and this is its most characteristic feature; (5) it is chiefly met with in children and young people; (6) it is sometimes followed by slight pigmentation and desquamation. The absence of all itching and irritation, and the pale and superficial character of the eruption make it easily overlooked, which is not a matter of much importance. In general appearance it resembles a superficial papular eczema, but can easily be distinguished by the absence of all subjective sensations. Its affinities are rather with lichen (keratosis) pilaris. Besides the above described form of lichen scrofulosus, there is also another variety in which the papules are larger, more discrete, and of a much brighter colour, but in which the *characteristic* feature of not itching is present. In the treatment of this disease, the internal use of cod-liver oil has been strongly recommended by Hebra. Arsenic is also very useful.

Lichen Pilaris, or Keratosis Pilaris as it is now usually called, is a hypertrophic affection of the hair-follicles rather than a true inflammation. The general appearance of this disease is that of a persistent cutis anserina. It is due to an over-distension and sometimes hypertrophy of the hair-follicles; this distension is caused by an accumulation of epidermic structures and sebaceous matter which collects around the hairs, and forms pale, firm papules about the size of small pins'-heads, or sometimes larger. In well-developed cases the papules are very numerous, and when the hand is passed over the surface of the skin it feels like a fine nutmeg-grater. The usual seat of this affection is the trunk, and the extensor surface of the limbs. It occasionally happens that the papules become a little inflamed, and then assume a red appearance which is attended by some itching; otherwise the patient is free from subjective sensations, and the papules are of the same colour as the skin. It is probable that this inflammation is simply accidental, and not an essential part of the malady.

Diagnosis.—There are two affections of the skin with which keratosis pilaris may easily be confounded—namely, lichen scrofulosus and the papular or follicular form of ichthyosis. From the former it may be distinguished—(1) by the hardness of the papule, and its obvious formation from over-distension of the follicle; (2) the arrangement of the papules, there being no tendency to form round or ringed patches; (3) the history of the case. From follicular ichthyosis it may be distinguished by the fact that keratosis pilaris is an acquired disease; but the two affections bear a very close superficial resemblance to each other. The treatment consists in the use of warm alkaline baths and the free inunction of glycerine.

Robert Liveing.

LIGATURES.—Hæmorrhage is best arrested by a simple ligature of the cut ends of the vessels. Large veins, when divided, occasionally require ligature. It is best to include as little of the surrounding tissue as possible, except when the arterial coats are diseased. Occasionally, as with the pedicle in ovariotomy, or the stump after hysterotomy, the vessels are best secured *en masse*. Growths such as nævus or hæmorrhoids may be treated by ligature.

Materials innumerable have been employed for the ligature of arteries. The best are silk and hemp, catgut, tendon, or ox aorta. Those ligatures are best which are most easily prepared. All ligatures should be perfectly aseptic; silk can be kept constantly in carbolic solution; the catgut in common use (from the intestines of the sheep) can be prepared best in carbolic or chromic acid. For the cut ends of arteries, catgut, when properly prepared, is the best material. The carbolised catgut should be removed from the oil and soaked for at least twelve hours in an antiseptic solution, but chromicised catgut may be kept dry, and only requires soaking in carbolic lotion for half an hour before use. The ligature then ceases to be slippery or brittle, and the knot will not yield. Animal ligatures disappear in the course of time, leaving the artery occluded, without setting up irritation. Silk ligatures, if really aseptic, may do the same, but frequently fail in this respect. Whatever the material employed, the inner coats of the vessel are usually ruptured; the flatter the ligature the less likely is this to happen. Secondary hæmorrhage is more likely to follow the use of silk than of animal ligatures. For the ligature of arteries in their continuity, animal substances are best. A single thread should always be used.

Method of Tying.—A reef-knot should always be used, and the knot made firmly without any jerk. In tying arteries in their continuity, the dissection should be carried down till the white coat of the vessel is exposed, and the ligature applied with a minimum of disturbance to the sheath. The artery should not be separated from its vascular connections for more than the width of the aneurism needle. By pressing the tips of the fingers down on the vessel in tying the knots, the danger of lifting up the artery from its bed will be obviated. The ends can be cut off short, and the cut sheath should meet over the knot when the wound is closed. Often, the internal coats can be felt to give way as the first knot is made, and when this happens, it is a proof that sufficient force has been exerted. The internal coats are ruptured with far greater ease than might be supposed. In a healthy artery, the absolute cessation of the pulsation below indicates that the vessel has been tied sufficiently tightly. The swelling of the ligature which follows when an animal material is employed, is more likely to increase the constriction than to diminish it, as usually supposed; for the knot, if properly tied, does not yield with the swelling of the ligature. The more diseased the vessel, the more deliberately should the first knot be made.

In dense, fibrous tissues, it is often very difficult to secure a bleeding point with the ligature. A good plan then is to pass a needle, threaded with a double ligature, through a portion of tissue near the vessel, as in acupressure. The loop is cut and both ligatures are tied, one on each side of the bleeding point. They are thus prevented from slipping off, and one or other will certainly include the vessel. For tying thick ovarian pedicles, and, still more, in tying the stump after removal of the uterus, silk ligatures are best. Spencer Wells's twisted silk is far the strongest and most reliable. Here, the first knot should be made with a double hitch, and tied very slowly and firmly; if the loose ends are pulled across each other the knot will not slip. After a few minutes the loop will be found loose as the fluids are pressed out; the knot is then again tightened. This process may require to be repeated several times before the reef-knot is completed; if this be not done, hæmorrhage is apt to follow.

C. T. Dent.

LIGHTNING, Accidents from.—These injuries seldom come under the notice of surgeons in this country, and most of our knowledge of the subject has been derived from the records of cases collected, from several sources, by Sestier and Boudin, and from the results of experiments made by Dr. Richardson in 1869. These injuries vary much, in different cases, in their character, intensity and extent, and though due in most instances to the action, more or less direct, of lightning, are at times the results merely of alarm and mental shock. In the most severe and fatal instances, the proportion of which to all the cases of injury from lightning is about one to four, the patient is killed at once, the body either falling suddenly to the ground, or becoming rigid and remaining fixed in a more or less erect attitude. In the more severe cases of the non-fatal injuries, the most marked general symptom is sudden and very profound collapse with unconsciousness, which condition is followed by drowsiness, fever, much prostration, and occasionally delirium and convulsions. A very frequent result of the injury is temporary paralysis of one or more limbs, associated in some instances with severe neuralgic pains, in others with complete anæsthesia of the paralysed region. Impairment of vision, and even blindness, have frequently been observed in cases of lightning injury, and these sequelæ, unlike the other results of lightning injuries, have in many cases a tendency to persist, especially when due not to nervous shock, but to progressive inflammatory changes in the choroid and retina. The long list of affections, that have been recorded as remote sequelæ of accidents from lightning, includes general debility, muscular weakness, vague fugitive pains, loss of memory, impairment of smell and taste, feeble circulation, coldness of the extremities, and the other well-known subjects of complaint common in those who have recovered from severe shock.

The external lesions caused by lightning also vary to a considerable extent, even in fatal cases. A person killed on the spot may present hardly any visible mark of injury, whilst, in some instances, the body may be much mutilated, and the bones of a limb or of the cranium widely comminuted and exposed. The clothes, in fatal as in less severe cases, may be left untouched, but are usually burnt and perforated at scattered points or along extended lines; or are reduced to shreds and torn away, leaving more or less of the patient's body quite bare. The most frequent superficial injuries from lightning are patches of cutaneous ecchymosis, burns varying in extent and severity, and dusky patches on the surface of the skin caused by the deposition of fused portions of metallic bodies—chains, coins, studs—carried by the patient at the time of the injury. Much attention has been directed to the so-called *keraunographic* images or arborescent impressions, that have been occasionally observed in cases of injury from lightning. These patches, presenting deep red lines, having a decided arborescent arrangement, correspond to the distribution of one or more subcutaneous veins, and are probably due, like similar appearances in the decomposing cadaver, to effusion of fluid blood along the course of the venous trunk and its branches. Arrest of the growth of the hair, followed by complete general or localised epilation, is another frequent result of these injuries.

In fatal cases of lightning injury, rigor mortis comes on rapidly, but the coagulation of the blood is usually much retarded. The most frequently observed post-mortem appearances have been: circumscribed effusions of blood under the serous membrane of the large cavities, extreme vascular injection of the coats of the intestines, and distension of the cerebral veins and sinuses. Instances of rupture of the heart, and also of the stomach, have been recorded.

In the *treatment* of severe lightning injuries, the surgeon has to deal at first with the condition of shock by applying warmth to the surface of the body, by administering stimulants by the mouth, rectum, or under the skin, and, in very severe cases, by artificially inflating the lungs. Each of the secondary and local affections requires the usual treatment of such condition. Under the influence of a proper and regular course of galvanism, the localised paralysis in most instances very soon yields. The progress of healing of the burns caused by lightning is often very slow, and in such instances, it has been stated, the action of the ordinary local remedies will be much assisted by the occasional application of electric currents to the injured region. W. Johnson Smith.

LINGUAL ARTERY, The, arises opposite the greater cornu of the hyoid bone, and, passing inwards parallel to the greater cornu and a quarter of an inch above it, finally ascends to the tongue.

The artery is divided into three stages by the hyo-glossus muscle, which crosses it—viz. a part posterior to, a part beneath, and, finally, a part anterior to the muscle. The second stage is the important surgical one. The digastric and stylo-hyoid muscles cross the artery obliquely, and divide it into two regions; the one below belongs to the superior carotid triangle, the one above to the submaxillary. The artery rests at first upon the middle constrictor, afterwards upon the genio-hyo-glossus.

Ligation.— Make a straight incision along the upper border of the hyoid bone for an inch and a half, dividing the cutaneous structures. When the deep fascia is opened, the posterior belly of the digastric is to be plainly made out; the hyo-glossus is then seen, with the hypo-glossal nerve and the lingual vein lying on it. Pull upwards the digastric and stylo-hyoid muscles, the submaxillary gland, the hypoglossal nerve, and the lingual vein. The hyo-glossus muscle being freely exposed, cut it lengthwise on a director immediately above the hyoid bone, where, beneath the muscle, the artery is found and secured. It is best to fix the hyoid bone by a tenaculum or forceps whilst the director is being passed beneath the muscle. Pass the needle from above downwards.

James Cantlie.

LINHART'S CHISEL. *See* Osteotomy.

LIPOMA (Fatty Tumour).—Three varieties of fatty tumour are recognised: The diffused. The single (fatty tumour proper). The multiple.

The *diffused* form is comparatively rare, unless the common 'double chin' be regarded as a growth; yet certainly in this region, as well as in those of the parotid, the sub-occipital, and in many others, usually near to the mesial line of the trunk, are to be found occasionally such definite masses of subcutaneous fat that the name of 'tumour' must be applied to them. Beneath the chin and in the perineum these swellings may seem single, but, otherwise, it is usual to find these lumps of fat placed symmetrically, and often there are many of them; and as the double chin is generally seen in men, so are these diffused fatty growths almost always found in men, and almost as constantly in young men.

The *single* variety is the well-known 'fatty tumour,' whose *locus* is always the areolar tissue, and which most frequently is subcutaneous; but lipomata may be found occupying inter-muscular spaces or forming an omental mass, occurring usually as a single tumour, though two placed symmetrically or more may exist in the same patient. Women appear to produce this form of lipoma more frequently than do men; certainly women seek advice for their removal in greater numbers than men, and although commonly seen in well-nourished subjects, this is by no means universally the case.

Fatty tumours occur most frequently upon the posterior plane of the body, and as a rule nearer the lateral borders than the spine; thus, favourite sites are the nape of the neck, the shoulders, and the scapular area generally, as also lower down the trunk, over the loins, the nates, and the region of the great trochanters. Sometimes, these fatty tumours shift their position by a process of gradual downward displacement, caused by their own weight acting on loose connections, and thus pendulous or even pedunculated fatty tumours are produced. They are at first usually of slow growth, but at any time are liable to increase rapidly. The largest the writer has seen grew from between the scapulæ, and weighed thirty-seven pounds.

The *multiple* variety, where three or more may exist in the same person, are usually found upon the extremities, the upper more often than the lower, and rarely grow larger than a filbert.

Causes.—A possible cause for the occurrence of diffused lipomata appears, by recent observations, to have been found in the fact that subjects of this affection are large consumers of ardent spirits. In the case of the common fatty tumour, taking into consideration the situations where these tumours are wont to be found, and that not infrequently such parts are subjected to pressure—as for instance the points of the shoulders in lying—it would not seem unreasonable to suppose that local irritation, inducing hyperplasia, may be regarded as a frequent exciting cause, whilst a general disposition to the over-production of fatty tissue is usually the predisposing cause. Family predisposition is often the cause assigned by the subjects of multiple lipomata.

Pathology.—As regards minute structure and arrangement, the microscopic appearances of the lipomata do not differ from those of normal fatty tissue. On inspection, after removal, a fatty tumour is seen to be made up of a series of lobes, with a very varying amount of fibrous tissue which radiates through the tumour, and also forms its capsule. This capsule is complete in the *single* and *multiple* forms, but, as its name infers, is wanting either altogether or in part in the *diffuse*. Lipomata are feebly vascular. They stretch the skin covering them and attenuate it, so that, either from friction or neglect, it may ulcerate and allow the tumour to herniate. The only form of degeneration that is common in fatty tumours is calcification.

Diagnosis.—The diffused lipomata vary in consistency, being either soft and doughy, or very hard and dense. They have indefinite borders, which fade off into the normal subcutaneous fat at some one aspect or in all directions; the skin is generally so closely blended with the fatty mass that it cannot be raised off the tumour, nor this from off the subjacent tissue. Lobulation may be very imperfect in this variety.

In a typical fatty tumour of the single class there is a well-defined roundish or oval swelling, the skin is commonly puckered over the tumour and loosely adherent to it, whilst the growth can be lifted up from off the subjacent structures. The tumour is easily displaced; it is soft and lobulated, and the softness and elasticity of these tumours is often so marked as to give rise to a most deceptive sense of fluctuation. Often fatty tumours are flattened out, and, as has been stated, they may be almost pedunculated, and this is likely to be the case when they are connected with the axilla or perineum. A fatty tumour has in the first place to be diagnosed from a sebaceous cyst, to which the skin is more closely adherent, and on the surface of which a black spot marking the obstructed orifice of the duct can often be seen; in the second place, from a chronic abscess or other fluid swelling, in which case, if doubt exists, aspiration will clear it up. Almost the only inconvenience which a fatty tumour produces is from its size. It is very seldom that patients make complaint of pain.

In the multiple variety, the little fatty masses are firmer, but still lobed, and often one or more are very painful on pressure; this form drifts into and can hardly be separated from the painful subcutaneous fibroma, the relative amount of fatty and fibrous tissue, and the more or less definite evidence of nerve-filaments forming a part of the growth, determining the point.

Treatment.—For the diffused lipomata, operative procedure is, as a rule, contra-indicated. A reform of the tippling habits, and the use of medicines which tend to cause absorption of the masses of fat, seem the more suitable plan of treatment, although, if very large and disfiguring, free cutting out of the overgrown structure may be performed.

Ordinary single lipomata should be removed by a free incision and enucleation of the growth; and, as the writer has seen recurrence follow an operation, a word of caution may be added, to remove the tumour thoroughly, for a small outlying lobe may very easily escape observation.

Multiple lipomata, it is clear, cannot be all excised; if one or two are the cause of much pain, they may be taken out; but here again the internal administration of such drugs as liq. potassæ in large doses, arsenic, iron, and iodine, forms the most appropriate treatment, together with strict regimen. Alfred Willett.

LIPS, Diseases of the.—*Malformations* of the lips are described under Cheek, Fissure of the; Hare-Lip; Nævus.

I. *Cracked lip*, though usually the result of dyspepsia or local irritation, may owe its origin to scrofula or syphilis. The simple variety is generally seated in the centre of the lower lip. There is little, if any, induration; the mucous membrane around may be more or less chapped. In slight cases no treatment is required, but if the fissure is obstinate it should be touched with lunar caustic, or anointed with some mild mercurial preparation. Healing may be hastened by checking the action of the labial muscles, by means of a piece of strapping passed below the lip from cheek to cheek.

II. *Ulcers of the Lip.*—(*a*) *Simple follicular ulcers* are frequently associated with disordered digestion. They are rarely larger than grape-seeds. Their edges are steep and sharply cut. They give rise to smarting pain, which is increased by mechanical or chemical irritation.

Treatment.—Any digestive errors are to be corrected by a saline purge and an alkaline-bitter tonic; and the ulcers touched with some mineral astringent.

(*b*) *Syphilitic* ulcers are of three kinds: (1) the primary sore or chancre; (2) secondary fissures and mucous tubercles; and (3) tertiary serpiginous sores.

Hard chancre may be acquired in various ways—e.g. the virus may be conveyed by the saliva, or by the secretion from mucous tubercles on the lips of another person, in the act of kissing; or it may be carried by a pipe, drinking-glass, or tooth-brush. Occasionally, inoculation is the consequence of lascivious practices. Infants may be infected from the cracked nipples of wet nurses the subjects of syphilis. As a rule, the chancre is less indurated than when seated on the genitals; its base may be purulent, sloughy, or even hæmorrhagic. On the other hand, the local signs may be so slight that the patient may not notice them. The lymphatic glands beneath the jaw, which are the seat of indolent bubo, are affected quite early. The other constitutional symptoms are not long in making their appearance. It is difficult, and it may be impossible in the early stages, to distinguish an infective from a non-infective chancre.

Treatment.-The ulcer should be covered with crystalline iodoform until it begins to heal, and the red oxide of mercury ointment then be applied.

Mucous tubercles are situated at the angles of the mouth and on the inner surface of the lips. The *cracks* or *fissures* of congenital syphilis often leave indelible scars, radiating from the corners of the mouth.

Treatment.—The broken surfaces should be brushed over with a solution of bichloride of mercury, $\frac{1}{4}$ to 2 grains to the ounce.

Tertiary syphilitic ulcers begin on the cutaneous surface, generally of the upper lip. They are often coated with thick foul scabs. The local *treatment* is the same as for the primary ulcerated chancre.

In each of the foregoing varieties of syphilitic ulcer the constitutional affection requires systematic treatment. Strict injunctions should be given to the patient to guard against conveying infection to others.

(*c*) *Scrofulous ulcers* consist of cracks or fissures: not rarely the muco-cutaneous surface is the seat of eczema. In addition to or even without ulceration, the upper lip may be permanently swollen from solid œdema, the result of chronic inflammation. The lip is prominent and carried away from the teeth. This is known as *Strumous lip.*

Treatment.—The digestive organs must be attended to, and cod-liver oil and iron administered. The fissures and eczematous patches may be painted with a mixture of equal parts of castor oil and oxide of zinc, or touched lightly with nitrate of silver.

(*d*) *Epithelioma* in its early stages resembles simple warty proliferation. On section, however, it will be found that in papilloma there is no invasion of the cutis vera, whereas in epithelioma the cutaneous and subcutaneous tissues are involved quite early, and at the same time there is induration of the base of the growth. The disease is infinitely rare in females. It is seldom met with under thirty, and, like other forms of cancer, it occurs with increasing frequency as age advances. With very few exceptions the lower lip is the part attacked. The rate of growth and ulceration varies within wide limits. At first the surface is merely cracked, or irregular from papillary hypertrophy. A little later it is covered with a scab, which on being removed leaves a granular-looking sore. On squeezing the part it may be possible to express some plugs of epithelium. As the destructive process advances, the part assumes a ragged, ulcerated appearance. The submaxillary glands become involved, and the gum or even the jaw may be implicated in the growth.

Diagnosis.—It is only in the initial stages that a doubt can arise as to the nature of the lesion.

From papilloma it is told by its tendency to ulcerate; by the induration of its base; by the possibility of dislodging epithelial-cell cylinders; by the enlargement, if any, of the submaxillary lymphatic glands; and lastly, in many cases, by the duration of the disease.

Epithelioma is more commonly mistaken for a hard chancre, and *vice versâ*; but a chancre is less warty or otherwise irregular, and the induration is more uniform and circumscribed. Again, the lymphatic glands are affected at an earlier date in chancre, forming indolent bubo. In the majority of cases, epithelioma is met with later in life than labial chancres, which are not infrequent in women. Corroborative evidence will be furnished by the absence or presence of other symptoms of syphilis, taken together with the known duration of the affection. When once the skin or mucous membrane has been destroyed by a syphilitic ulcer, no epithelium is found in its base, whereas in epithelioma it is quite plentiful.

The writer's experience leads him to conclude that no great reliance can be placed on the results of microscopical examination of scrapings from the surface. It is quite possible to mistake the tips of hypertrophied papillæ for cell-globes.

Treatment.—Nothing short of complete removal is of the least avail. The usual plan of operation is to excise the growth with the entire thickness of the lip, by means of a V-shaped incision. Care must be taken that the cuts are made quite clear of the diseased tissues, otherwise recurrence will be certain and speedy. There can be no doubt that, when practised early, this plan of treatment suffices to effect a permanent cure in some cases. Even when the gum or jaw is deeply invaded, the surgeon should advise an operation if the whole of the tumour can be got away, and the condition of any infiltrated cervical glands is such as to allow of their complete extirpation. If the disease is left to itself there is but one termination—death, and that in a horribly distressing form; the patient being worn out by absorption of septic matter from the ulcerated gangrenous tissues; by repeated attacks of hæmorrhage, which it may be difficult to arrest, and by the passage of decomposing discharge into the stomach and lungs. For the more serious operations, no rule can be laid down with regard to the incisions suitable to all cases. It may be expedient to close the gap left after removal of the mass by means of a plastic operation. The directions for such a procedure will be found under Cheiloplasty. It may be added that these extensive operations are the more justifiable, since it is quite exceptional for the viscera to be affected with secondary growths. It is surprising what little deformity is left, even when the greater part of the lip has been excised.

III. *Adenoma of the lip* commences in proliferation of the glandular epithelium. It is composed of tubes and acini, the latter predominating. It is a rare affection, and generally slow in its march. The inner surface of the tumour, which is covered with mucous membrane, may be flattened by pressure against the teeth and gums, whilst the outer surface presents a uniform swelling under the skin. In addition to the glandular structure there may be a considerable quantity of fibrous and mucous tissue; in fact, these growths bear a strong resemblance to the mixed tumours of the parotid. In one case the growth contained a nodule of bone. Occasionally they are cystic.

Treatment. — If possible the tumour should be enucleated without dividing the lip. The best plan is to make a free incision over the inner surface of the swelling.

IV. *Labial cysts* arise for the most part from distension of mucous follicles, but there may be free cyst-formation, possibly from dilatation of lymphatic spaces. They can generally be seen projecting beneath the mucous membrane as semi-transparent vesicles, as if a white grape were embedded in the tissues of the lip. The contents are usually viscid, and are either colourless or yellowish.

Treatment.—If small, the entire cyst may be removed; but, rather than damage the surrounding structures, it is better to excise a portion of the cyst-wall. In the latter case to prevent refilling, the inner surface should then be rubbed with solid silver nitrate or brushed over with strong nitric acid.

V. *Herpes labialis* is commonly seen as a crop of vesicles at the junction of the skin and mucous membrane. *See* Herpes.

VI. *Pigmentation* of the mucous membrane of the lip occurs as patches in Addison's disease. It is of no surgical import.

VII. *Aneurism by anastomosis* of the facial artery and its branches may involve the lip. *See* Cirsoid Aneurism.

Augustus J. Pepper.

LISTER'S SPLINT for excision of the wrist is an anterior forearm splint, with a cork pad at one end for the hand to rest upon with the wrist extended and the fingers slightly bent, and a cork ledge projecting on the radial side for the thumb to rest upon.

LISTON'S LONG SPLINT is a wooden splint, reaching from the axilla to six inches beyond the sole of the foot. It has two notches at the distal end so as to give the ankle bandage a firmer grip of the splint, and two holes at the other end for the perineal band to be attached to. The middle of the band should be accurately adjusted over the ischial tuberosity, and its two ends should be carried, one in front of the groin and the other behind the buttock, to the holes in the axillary end of the splint. Extension should be made by pulling on the foot and the lower end of the splint, and then the ends of the perineal band should be tied together to maintain the extension. Bilton Pollard.

LITHOTOMY. — This and the next article deal simply with the surgical treatment of stone in the bladder by operation —the varieties, the obstacles and dangers met with, the results, and the applicability of each method of proceeding. For the symptoms, diagnosis, and medical treatment of stone, *see* STONE IN THE BLADDER. The writer has not attempted to treat the subject exhaustively; he has been compelled to omit many references to authorities, and even to leave unnoticed varieties of instruments and operative measures which are now but seldom used or adopted. He has rather aimed at giving, in a concise and practical manner, his own reflections on lithotomy and lithotrity, formed after a fairly long and full experience extending to just 300 cases of operation in his own practice, and probably as many more in that of his colleagues and friends.

Not all patients who have stone in the bladder should be advised to submit to operation. Some suffer so little from the presence of even a very large stone, that it would be wrong to place their lives in danger by resorting to lithotomy; while some others are unfit for any operation because of the presence of serious organic disease, urinary or otherwise. Let it now, however, be assumed that, after due consideration, a patient is about to undergo an operation.

LATERAL LITHOTOMY IN THE ADULT.—The instruments required are, or ought to be, few. Staffs, a knife, Prichard's anklets, forceps, scoops, a sound or searcher, possibly a blunt gorget, a drainage-tube, a tampon, and a syringe, are all that can be required.

The staff should be of moderate rather than of full size (the former is just as easy to find, and does not oppose the introduction of the finger so much as a large one), with not too long a curve or too sharp a point, for fear of injuring or even perforating the posterior wall of a contracted bladder; the lateral groove should be wide rather than deep, and extend to and end abruptly at a quarter of an inch from the end. The knife usually sold as Liston's is the best shape, with the back nearly straight, of a good width, the cutting edge terminating an inch and a quarter from its point; the blade three, and the handle four, inches in length. The forceps should be always straight—curved are unnecessary and inefficient—the blades sufficiently hollowed that they will hold a stone fairly by their surfaces and not merely by two points, and yet not so hollowed as that the tips of the blades would be likely to break the stone if only half-grasped; the inside of the blades should be roughened, or, what is better, lined with linen, which diminishes the risk of breaking the stone. The scoops usually sold are of little use; they should not be double-ended, but firmly fixed in a good-sized bone or wood handle, of various sizes, and well curved, so that if a stone or piece of stone is fairly engaged in one, it can be withdrawn by a combination of traction and leverage. The gorget can seldom be needed; for upwards of thirty years it has scarcely ever been used in Norwich, and now the hospital does not possess one. Cases frequently occur in which the finger cannot reach the bladder; but the forceps will always readily enter it and will act as the best dilator. A tube of some kind to secure, after the operation, perfect drainage and repose of the bladder is of infinite advantage. It is usually made of gum-elastic material, but many years ago the writer suggested the use of a double silver canula, sheathed so that it can be drawn out according to the distance of the bladder from the surface; it should be about the size of No. 18 catheter, with a well-bevelled end and numerous small holes for about an inch. These small apertures are better than one or two larger ones, because if the tube has to be retained several days, the swelling of the wound's surface may cause the granulations to bulge into these apertures and make its withdrawal painful, and even cause a little bleeding.

No special preparation of the patient is called for beyond a judicious diet for a few days, a mild laxative if necessary, and an enema shortly before the hour of operation. The table for the patient and the chair for the surgeon should be of such relative heights, that the latter can easily proceed without having to raise his hand and arm uncomfortably.

While the anæsthetic is being administered, the anklets may be adjusted. The two assistants who support the legs must be mindful of their duties, which are, to keep the patient in a straight and immovable position, with his thighs well flexed on the body and the knees symmetrically separated. This is best done by folding one arm over the patient's knee, with the forearm and hand along the inner side of the leg, the other hand supporting the foot, but ready at any moment to assist the operator if required. The staff may be introduced either before or after the anklets are locked; if before, care must be taken that it is not driven in upon the bladder during the rough movements of flexing the legs. The presence of a stone will be verified by the staff; if any doubt on this point is felt, a sound should be substituted and a proper search made, and if still the stone cannot be detected, the operation must be postponed. This, however, will very seldom happen; in several hundred operations the writer has only once known it occur, and that was in the practice of Mr. Liston. The patient, a fat, elderly man, with an enlarged prostate, had twice been removed from the table; on the third attempt, although the stone had been felt the day before with the sound, the staff did not strike it at the time of operation. When the bladder was opened and the forceps were introduced, still no stone could be felt; there was free bleeding, and a clot was entangled in the blades of the forceps, and in this clot were two small stones which had been unconsciously removed. The position of the staff is a matter of importance: instead of keeping its handle perpendicular, the staff-holder should incline his hand considerably towards the patient's abdomen, and gently push the convexity of the staff towards the perineum. The effect of this, as verified by dissection, is to bring the membranous urethra slightly nearer to and almost parallel with the surface of the perineum; the groove is more easily reached, the operator has no inducement to open the urethra too far forwards, and the bulb and its artery will probably escape being cut. The end of the staff need not, by this plan, be withdrawn from the bladder; but if it were, it would be immediately replaced when the staff is brought into the perpendicular position and hooked firmly under the pubic arch, before the deep incisions are made.

Before commencing the operation, the finger is passed into the rectum to ascertain that it is empty, to note the size of the prostate, and to secure the proper position of the staff. The first incision should be about three inches in length or more, according to the estimated size of the stone and of the prostate; the freer the incision, the easier it is to bury the knuckles in it and reach a deeply-placed bladder. The knife is entered perpendicularly rather more than an inch above the anus, and a little to the proper left of the middle line; this first puncture should be of some depth, but not deep enough to touch the staff: should it do so, it may be assumed that the urethra has been opened too far forward, and free bleeding may be the needless result. The direction of the incision should be well towards the tuberosity of the ischium—nearer, that is, to it than to the anus. The left forefinger is then pressed deeply along the upper angle of the wound, and the staff felt for; it can always be found, but it is not easy to place the finger-nail on the edge of the groove. This would require a good deal of rotation of the hand, and the uncut tissues prevent it; it will suffice if it rests fairly on the staff. The surgeon, keeping his eye on the latter, will slip the knife along the back of the finger and will easily find the groove; if there is any difficulty, the knife is not to be at once carried deeper, but its point should be moved laterally, without cutting, when it will probably be found to touch the staff on one side or other, and the groove will be quickly entered. This being done, the staff is raised into the perpendicular position and hooked firmly up against the pubic arch, as before mentioned, the knife following it, and then being pushed cautiously along quite to the end of the groove in the bladder. Young operators sometimes find this a little awkward; they are so strongly cautioned against allowing the knife to leave the staff that they direct it upwards, and its point, impinging against the metal, will not readily glide along; it is only necessary to raise the hand a little to make it slip forwards. The beginner should practise this before operating, and the proper adaptation of the knife and staff will soon be acquired.

The next step is one of delicacy and importance. It is useless to withdraw the knife in the same line as it entered, unless the stone is very small; some division of the prostate and neck of the bladder is necessary, and it is now to be made by a draw-cut. The knife, with its edge well lateralised, is to be pressed gently but steadily downwards and outwards as it is withdrawn, the pressure diminishing by degrees to nothing as the external wound is reached. Only experience can guide one aright at this stage. Those who prefer a free incision, with its risks of hæmorrhage and extravasation of blood or urine, will use more pressure; and those who prefer a small incision, with the certainty of laceration, will use less: the safe course is the medium one.

The left index finger is now passed along the groove into the bladder, and the staff is withdrawn. The depth of the bladder, the size and position of the stone, and the extent of the deeper part of the wound are ascertained. The finger is to be used to dilate the neck of the bladder in all directions, employing pretty strong pressure in doing it, and so making a smooth path for the entry of the forceps and for the further dilatation of the vesical orifice. Martineau and Liston laid great stress on this dilatation by the finger. Having ascertained the size of the stone, the surgeon selects the forceps, taking care not to fall into the mistake of using too small a pair; he passes them along the upper or dorsal surface of the finger, withdrawing the latter as the forceps enter. The blades should be fully introduced before opening them—this is done slowly and in a lateral direction—then, by giving a quarter turn to the handles, one blade is made to sweep round to the lower fundus of the bladder, and by this manœuvre the stone will almost certainly be caught. If it is not, the process will be repeated, and, if there is still a difficulty, the surgeon will ascertain if he has not passed over the stone, which is not infrequently found close behind the prostate and beneath the forceps; if this be so, he will withdraw them slightly, elevate the handles, and repeat the rotatory movement. Sometimes, though rarely, the stone is entangled or held by irregular contraction of the bladder at the upper fundus, in which case the handles should be lowered and the blades directed upwards, while an assistant makes firm pressure above the pubes. The large size of the stone sometimes makes it difficult to grasp it; in this case the operator will withdraw the forceps, perhaps take a larger pair, and having ascertained with his finger the exact position of the stone, he will introduce them so that the tips of the blades impinge on it; then by slowly opening them they will be found to glide over each side of the stone, and a good hold is obtained.

All these manœuvres are to be slowly and gently conducted, and there should be no wild 'digs' at the stone or sudden alterations of method. The extraction should be deliberate and steady, the direction somewhat downwards, the blades and handles of the forceps kept in a vertical position, and no rotation made as the stone advances, for fear of injuring the prostate and neck of the bladder. Should there be much resistance and no sense of gradual yielding, the surgeon will ask himself the question whether this is due to an insufficient opening, or to the projection of the ends of an oval stone laterally beyond the blades. This latter may be known by observing that the bladder is brought bodily down, so that the prostate, which is probably large, is visible near the external wound; in this case, the stone must be liberated, the finger again introduced, and a fresh hold taken. If the obstruction is due to a large stone and too small a wound, the latter is to be enlarged in the direction of the first incision; this, in the opinion of the writer, is preferable to making a division of the neck of the bladder on the opposite side, and preferable, too, to using undue traction force. The stone being removed, the bladder is again fully examined with the finger, and if necessary with a searcher, to see if another calculus or piece of one remains; any bleeding vessels are to be tied, or the wound plugged, as will presently be described. The silver tube is introduced and secured by tapes and a bandage round the body, a morphia suppository put into the rectum, and the patient placed in bed with hot bottles to his feet.

The after-treatment is very simple. The bed should be a firm hair-mattress, protected by a waterproof, and plenty of old sheets cut into squares for frequent removal; a rope and cross-bar should be arranged above, so that with his hands the patient can raise his hips without undue exertion. His knees are to be supported by separate pillows, with an interval between them, so that the light is not obstructed and the tube can easily be got at. This must be kept free, by a feather or a small sponge on a wire, so that the urine shall easily pass, and clots be removed if necessary. The secretion of urine is often scanty for the first twelve or twenty-four hours, and then it flows freely; if it ceases, and the patient is in pain, the tube should be gently pushed a little further in, or a flexible catheter may be passed through it into the bladder. In ordinary cases the tube may be withdrawn in thirty-six hours, but if the prostate is large or if the patient had been compelled to use the catheter previously, it will be right to retain it three or four days or more; and even then it will, in the cases just mentioned, be requisite for the nurse or surgeon to draw off the urine by passing a catheter through the wound as often as may be necessary, until its use by the urethra is resumed. If the urine is alkaline and acrid, the skin of the perineum and nates is apt to be excoriated, especially in the aged and feeble; and this is to be guarded against by frequent washing and change of bed linen, and by the free application of zinc ointment. In these cases, much benefit will accrue from washing out the bladder with Condy and water or boracic water, twice or thrice daily; the deposit of phosphates, which coats the surface of the wound and may lead even to phosphatic concretion and recurrent stone, is thereby lessened, and the cystitis is greatly alleviated. The diet should be simple and good; a mild aperient may be taken on the third day, and, if requisite, it should be aided by a simple enema. The urine generally begins to flow by the urethra between the end of the first and second week, depending somewhat on the size of the stone and the condition of the patient; and the external wound is generally healed, and the cure complete, within the month.

The Obstacles met with in lithotomy are chiefly due to—1, the large size of the stone; 2, enlarged prostate; 3, breakage of the stone; 4, encysted stone. (1) The mode of dealing with large stones has already been briefly described. In these days of anæsthetics, stones of such magnitude as are described in the *Medico-Chirurgical Transactions*, vol. xi., are not likely to be met with. The largest in the Norwich Hospital weighed nearly thirteen ounces, and the surgeon failed to extract it. There is, however, a stone in the hospital museum which weighed nearly fifteen ounces; it was successfully removed by Mr. Harmer in 1746, assisted by Benjamin Gooch, who, in describing the operation, says: 'I divided the parts occasionally as he continued to make a gentle extraction.' This sentence describes pithily the best mode of removing stones of large size; it means practically a judicious combination of dilatation and cutting, and probably some rupture of tissues. It is far better than attempting to break a hard compact stone, by which serious injury to and sloughing of the soft parts are likely to be produced. In the present day, however, it is probable that stones weighing upwards of three ounces will be dealt with by the improved method of supra-pubic lithotomy.

(2) Enlarged prostate, undoubtedly, is sometimes a serious obstacle in lithotomy, and if it is combined with a full-sized stone the difficulty is very considerable. The bladder is probably beyond reach, and the size and position of the stone cannot be accurately known. Still, the finger will reach well into the prostatic urethra; the knife has already made a free incision, and the forceps will readily pass in. It is in the extraction that the trouble lies; the rigid prostate will not easily dilate, and if the stone is of any magnitude, there is certain to be some yielding of tissue. This rupture always takes place below, at the thinnest part, so that, when the wound is examined after the extraction of the stone, the gland seems to be, and indeed is, separated into two lateral lobes. If the median portion projects prominently into the bladder, it may get entangled in the forceps and be torn off, or a fibrous tumour in one or other lobe may be forced out by the stone as it passes. This accident has been deemed by some surgeons as of no disadvantage, but it is probable that a careful examination of the subsequent condition of such patients would show that, although it may not have endangered life, it has not infrequently been followed by partial inability to retain urine.

(3) The breaking of the stone in the forceps has two disadvantages: it makes the repeated use of instruments necessary, and, what is of more importance, it entails the risk of leaving a fragment behind. The same may be said when there are a number of small stones. Nothing requires more deliberate care and perseverance on the part of the surgeon than the entire clearance of the bladder under these circumstances: small fragments, or small stones, are apt to be surrounded by clots or viscid mucus, or to get into the recesses of the mucous membrane, and are not easily detected by the searcher or even by the finger. Frequent syringing with a Higginson's enema and a small flexible tube, so as to search every part of the bladder and allow of a free return stream, and the careful exploration with the sound and finger, are all that can be done; but the case should be narrowly watched after the operation, and if, within two or three weeks, the patient should complain of pain when the bladder contracts, a sound should be used. If a small piece of stone is detected, an attempt may be made to extract it by means of long slender forceps through the wound; or the latter may be dilated with the finger, and forceps of adequate size used; or, what perhaps is a better plan, the wound may be allowed almost to heal, and a lithotrite be applied to complete the cure. Recurrence of stone within two years almost always means that a fragment has been left after the operation. No greater disappointment than this, both to the surgeon and the patient, can happen. No one, probably, has cut fifty patients without having to admit and lament its occurrence, but it is especially liable to occur to the inexperienced.

(4) The stone may be encysted, and this constitutes a very dangerous and puzzling obstacle. Fortunately it is rare, but the writer has met with at least six or eight instances. Each case will present peculiar features; no rule for general adoption can be laid down, and the surgeon must decide, at the moment, how to attempt to remove the stone, and how far to persist in such attempts and when to desist. Sometimes, one or more stones are lying free in the bladder and can be easily removed, and then the finger, in making a thorough exploration,

feels the point of one that is hidden in a sac or cyst. Possibly, the surgeon may succeed in dilating the mouth of the sac with his finger, and possibly, also, he may be able with forceps or, more likely, with a long narrow scoop curved almost to a right angle, to dislodge and remove it. This manœuvre will only occasionally succeed, however, and it will be prudent to leave the stone embedded, in which case all that can be done will be to remove, with the lithotrite, from time to time projecting masses of phosphates, which are sure to grow up into the cavity of the bladder. In this way the patient's comfort may be promoted for a time, but ultimately he will sink from cystitis.

The Dangers of Lithotomy are—1, hæmorrhage; 2, wound of the rectum; 3, perforation of the bladder. (1) Hæmorrhage is either primary or secondary; that which comes from the transverse artery of the perineum or any other, in the first incisions, may be disregarded at the moment; it generally ceases as the further steps of the operation proceed, and the vessel can be tied when it is concluded. The artery of the bulb should not be cut, but it frequently is, especially by beginners, who are naturally anxious to reach the staff, and who make their incisions too far forward; it is not easy to place a ligature on it, but pressure-forceps will control it, and may be left on for a day or two. Deeper sources of arterial hæmorrhage, and that which comes from enlarged hæmorrhoidal or prostatic veins, must be dealt with by the plug, either the air-tampon of Buckston Browne fully introduced and moderately distended, or by long strips of dry lint pushed with a blunt instrument deeply all round the silver tube. The end of each piece is left hanging from the wound, and so placed and noted that, when the time comes for removing the plug, the last piece which was put in may be the first withdrawn. The wound, however, should be plugged with reluctance, it is always an evil; it offers some obstacle to the free escape of urine and serous discharge, leads to ecchymosis around the base of the bladder and in the pelvic cellular tissue, and presses, sometimes injuriously, on the neighbouring soft parts. Before resorting to it, ice may be applied to the perineum and cold water injected into the bladder, and the case watched for a short time. Should, however, the loss of blood continue actively, and particularly if it should recommence after an hour or two, when the patient is warm in bed with reaction fully established, and if it be accompanied by vesical tenesmus and the forcible expulsion of clots, the case must be resolutely dealt with at once. The patient should be brought to the edge of the bed in a good light, the tube removed and cleansed, the finger introduced into the bladder and coagula removed as far as possible; and then the tube is to be replaced and a fresh plug or tampon introduced. Secondary hæmorrhage is a much more serious danger; it may come on in three or four days from the softening of restraining clots, or in one or two weeks from the separation of sloughs. It sometimes occurs without pain or the knowledge of the patient; sometimes, it begins with a rigor and the expulsion of coagula, with straining. At first, ice-bags to the perineum and above the pubes, or the injection of cold water, may be tried; but if the bleeding recurs to a serious amount, the re-insertion of the tube and plug, thoroughly and firmly applied, is chiefly to be depended on. Happily, it is very rare to meet with a death from hæmorrhage, however near to it apparently the patient may be brought.

(2) Wound of the rectum may occur in various ways. Above the internal sphincter the ampulla of the bowel approaches very near to the membranous urethra, and it may easily be injured if the knife is not sufficiently lateralised while making the deeper incisions; or sloughing may follow the extraction of a large stone some time after the operation. In any case it will be right to do nothing for a time; nature is often competent to bring about a complete cure as the healing goes on. If not, the perineal wound may close and a recto-urethral fistula will remain, and, so remaining, a slight exchange of the fluid contents of either canal may take place with but little attending inconvenience. Should the perineal wound not heal, and there is a free communication with the bowel close above the sphincter, the latter should be divided; but this will seldom be required. Caustics or Paquelin's cautery carefully used will lead to contraction, and time will aid much.

The perineal wound may be slow to heal, either through injury done by the forcible extraction of a large stone, or through the feeble condition of the patient leading to the deposit of phosphatic matter on the entire surface of the wound. By degrees this coating comes away, but it sometimes happens that little cavities may be formed in or near the prostate, and so the complete and firm healing of the wound is delayed. It may even happen that some particles of this phosphatic covering may pass into the bladder or remain in the prostate, and so give rise to future trouble and recurring stone. This condition of things should be carefully watched; frequent syringing through the wound with boracic or acidulated water early in the case will tend to obviate it, and remove the incrustation and prevent the consequences named. The insertion of probes coated with nitrate of silver or the wire cautery will expedite the healing of a clean sinus, but, here again, time and the restoration of the patient's strength are important aids to full recovery.

(3) Perforation of the bladder is an accident which can rarely happen. It may occur in a contracted bladder with a staff having too long a curve and too pointed an end, and especially if the surgeon, taking the staff in his left hand, pulls it somewhat towards himself as some surgeons do who use the gorget; the knife can never injure the bladder if its point is carefully kept within the groove. The accident is probably not suspected at the time, but rapid and overwhelming peritonitis quickly sets in, and the misfortune is only discovered at the autopsy.

The Causes of Death after Lithotomy are various—shock and exhaustion; suppression of urine and kidney disease; phlebitis and pyæmia; and extravasation of urine. The last was considered, by the older surgeons, to be by far the most frequent of the fatal effects of lithotomy. At the present time this is by no means admitted to be the case; it is probable that, with the advance of pathological knowledge, the causes of death which used to be attributed to infiltration of urine are now recognised to be due to other conditions. When it does occur it may be looked for about the third or fourth day or later; it is often insidious in its approach; there may or may not be a rigor, little or no pain, probably some tenderness of the lower abdomen; dry tongue, fever, anorexia, hiccup, exhaustion, and death. Sometimes it is accompanied by tympanitic distension and peritonitis, and sometimes, too, its progress is milder and the condition ends, not necessarily in death, but in pelvic abscess, which may find an escape through the wound or bowel, or be reached by incision of the abdominal wall. The treatment of these various conditions is not materially modified by their connection with lithotomy, and need not be specially described here.

Lithotomy in Children is modified by the anatomical conditions that the bladder is situated high in the pelvis, the prostate is wholly undeveloped, and the urethra very small; this last fact alone constitutes the chief difficulty and risk of failure. The incisions, although they will properly be made more freely in proportion than in the adult, must still be limited, and the attempt to pass the finger along the staff—which already fills the urethra—is fraught with the risk of separating the bladder from its anterior connections, pushing it back away from the staff, and failing to reach it altogether. In a young child, the least force used at this stage of the operation will end in this failure, and gorgets, dilators, and other contrivances have been designed to obviate the difficulty; but these instruments themselves require very careful handling, and have sometimes, in the hands of inexperienced operators, led to disaster. The writer has never used them, but has proceeded in one or other of the following ways:—The staff being exposed and the resistance to the finger recognised, the surgeon will consider the position, and, if he has the least doubt as to the sufficiency of his incision, he will again use the scalpel or a probe-ended bistoury and extend it, and again try his finger; should its passage be still resisted, he may introduce easily a pair of ordinary polypus-forceps along the groove, and dilate the neck of the bladder by opening the blades; he may even carefully seize and remove the stone with them, or, having stretched the parts open, he may introduce his finger and the lithotomy-forceps or scoop in the usual manner. Another method the writer has frequently adopted is this: when the staff is well exposed and the deep incision made, the tip of the left forefinger is placed on it, but no attempt is made to pass it into the bladder until the staff is withdrawn; then the finger is gently wormed along the empty urethra, dilating it as it goes. With an empty urethra and a proper incision, he has never met with any real obstacle to the passage of the finger; there is no other route open to it, and it is only a question of sufficient or insufficient room. But here, as always, the golden rule of avoiding undue force must be remembered, and, if resistance is met with, the staff should be reintroduced and the knife again applied. With this exception, the other steps in the operation in children are similar to and more easily carried out than in the adult. Urinary infiltration is so little to be dreaded in children that it is not necessary to use a tube; moreover, it is difficult to restrain the sudden movements of a child during sleep or even when awake, and on this account a tube is objectionable.

Median Lithotomy is performed as follows:—The staff, of moderate size with a central wide groove, is held as in the lateral operation, with its handle inclined towards the umbilicus. The left forefinger is passed into the rectum, with its tip resting against the apex of the prostate. Keeping it steadily there as a guide to the membranous urethra, a long narrow bistoury, double-edged near its point, is passed, with its back towards the bowel, through the raphé of the perineum straight into the staff. Having reached the groove, and the handle of the staff being replaced in the perpendicular position and hooked well up against the arch of the pubes, the knife is pushed slightly towards the bladder so as just to nick the apex of the prostate; then a forward cut is made along the groove for nearly an inch, in order to divide the membranous urethra, and as the bistoury is removed a draw-cut upwards is carried through the central line of the perineum to the requisite extent. The operation is then completed as in lateral lithotomy. Some operators prefer to reach the staff by dissecting down to it; but the plan advocated above is simpler, and is perhaps less likely to wound either the bulb or the rectum.

The advantages of the median over the lateral operation are: the somewhat smaller amount of cutting, the rapid recovery in favourable cases, and the slight injury done to the neck of the bladder, but these advantages are only obtained when the stone is small; when it is large the difficulty of extraction is considerable, and laceration of tissue is unavoidable. The disadvantages are: the liability to wound the bowel, which lies in immediate and dangerous proximity to the wound; the frequent occurrence of troublesome bleeding, which can only be arrested by the tampon or the plug, and the general want of room and space for dealing with stones of some magnitude. It is true that the writer has removed a stone by this method which weighed nearly five ounces, but he believes that, with the lateral operation, the manipulation would have been easier and the recovery of the patient quicker. Some years ago, the surgeons of the Norwich Hospital gave median lithotomy a fair and extensive trial, the writer alone having had upwards of fifty cases, and the result was that he and his colleagues have all but relinquished it both for children and for adults. The advantages seemed to them to be on the whole less than the disadvantages, and the results were not more favourable than in the lateral operation, if so good. It is suitable only for small stones, and these, for the most part, are best dealt with by lithotrity.

Supra-pubic Lithotomy, since its first introduction by Peter Franco in 1541, has experienced many vicissitudes. In its first century it awakened great hopes of success, which, however, owing to repeated failures gradually faded away, and it fell into disrepute until about the beginning of the last century, when it was revived and adopted amongst others by Cheselden, who practised it with such success that surprise may be felt that he ever relinquished it. He was, however, induced to do so, not by any dissatisfaction with it, but by the hope of even greater success from the adoption and modification of the perineal operation of Raw. The lateral method, when it became stamped by the sanction and success of Cheselden, took its place firmly, and again the high operation became obsolete. During the last thirty years it has been practised some forty or fifty times in America, as may be seen in a good paper on the whole subject by Dulles in the *American Journal of Medical Sciences*, July 1875; but its success was not sufficient to recommend it to English surgeons, who have been content to adopt it, unwillingly, only in cases of unusually large stones.

In 1880, however, a fresh impulse was given by the improved method of operating suggested by Professor Petersen of Kiel. He noticed the effect of fully distending the rectum in causing the bladder to project above the pubes, so as to bring it within easy reach and to remove the anterior fold of the peritoneum well above the risk of injury by an incision. This indeed was fully demonstrated by Dr. Garson in a paper published in the *Edin. Med. Journ.* for October 1878. He distended the rectum by introducing a rubber bag and filling it with water. The bladder having been also distended, the body was frozen, and a vertical section of the pelvis made and accurate observations and measurements taken. These observations made by Garson, when under Professor Braune of Leipsic, may be said to have laid the foundation of the present mode of conducting the high operation.

Operation.—The patient rests on his back near the end of the table, with the knees elevated and separated. The surgeon first introduces a catheter, washes out the bladder with boracic water, and fills it slowly and carefully with the same as full as it can easily bear. The catheter is withdrawn and the water retained by a ligature on the penis. The india-rubber bottle is next introduced into the rectum. This bottle is made of thin rubber; it is pear-shaped, with a long tube at one end through which to fill it. It is introduced empty by folding it longitudinally and dipping it into carbolic oil. Warm water is slowly injected by a common enema syringe through the long tube. The water is contained in a pint-glass graduated measure, so that the exact quantity used can be watched; this is a matter of some moment, for, if an excessive quantity be introduced, there will be risk of rupturing the coats of the rectum. Petersen says as much as 21 oz. (avoir.) may be used; but this would probably be seldom required, and from 12 to 16 oz. will be found sufficient. The writer in one case used 18 oz., and it was noticed that when, after the stone had been removed, the bag was emptied and withdrawn, a teaspoonful of blood escaped. The patient died of kidney disease and suppression of urine, and it was found, on post-mortem examination, that the mucous membrane, and even the circular muscular fibres, of the bowel had been ruptured at the upper or bladder side, and that there was some ecchymosis and sloughy tissue around the injured part.

The patient's legs are now lowered, and an incision about three inches long is made in the median line, the lower end of which comes well over the upper border of the symphysis pubis. The operator works his way between the recti and pyramidales muscles, nicking them on each side if necessary, until he comes to the loose fat which covers the bladder wall; this is scratched through by the finger-nail or handle of the knife. The peritoneum will probably not be seen, for the fold of it will be an inch or two above the knife. The bladder being exposed, a tenaculum or hook is used to steady it, and the knife is dipped into it on a level with the upper border of the pubes, and the wound is extended a little upwards and downwards. The water immediately gushes out, and the stone is felt with the finger close at hand. In some cases, when it is small, it can be removed with the finger alone or aided by a scoop; but with large stones, for which alone English surgeons are likely to resort to the high operation, forceps of adequate size must be used. The edges of the bladder-wound may require to be held up and steadied by delicate hooks, during this manipulation. Extraction should be slow, and very little force used, for it is better to extend the incision upwards rather than bruise the wound by over-stretching. The wall of the bladder is apt to bleed rather freely, but it soon ceases, and any little vessel may be secured by ligature if necessary. A full-sized, long drainage-tube is passed fully into the bladder, and secured by a thread to the margin of the external wound. The upper part of the bladder wound is closed by two or three fine catgut or silk sutures : the upper part of the external wound, too, may be closed, the lower part being left open for the escape of blood or other fluid. Oiled lint and absorbent bags are secured around the tube, and the patient is placed in bed on his side, with the free end of the tube in a basin by the side of the bed. When this position becomes irksome, he may turn on the other side, care being taken that the tube is properly placed and the dressings not disturbed.

Some surgeons recommend that, in addition to the tube, a catheter should be retained in the bladder through the urethra; others that no tube should be used, but the aperture in the bladder wholly closed and the bladder drained, either by a catheter tied in, or by a tube introduced through a perineal opening. On this point, and in several details of the operation, further experience is wanted for trustworthy guidance. So also, it is too early to speak of results. Petersen, and Guyon of Paris, have had fair success, but the number of cases is at present too small to admit of comparison with lateral lithotomy. The chief danger to be apprehended is from extravasation of urine behind the pubes, in the loose cellulo-adipose tissue around the bladder. Peritonitis, which used to be the too frequent result of the high operation, was due to direct wound of the peritoneum; now, however, this can scarcely happen, and peritonitis will only occur as a secondary consequence of urinary extravasation. From shock, from hæmorrhage, from possible impotence, from wounds of the rectum and perineal fistula, which are the occasional results of perineal lithotomy, the supra-pubic method will be free. The operation is easy to do, and unless it turns out to have a heavy mortality, it is almost certain to take a high place in professional esteem, and to supplant all other methods for the removal of large stones.

Lithotomy in the Female, whether adult or child, is still surrounded by several undecided questions. Stones, of small or even of moderate size, may safely be removed by dilating the urethra with the three-branched screw instrument so as to admit one or two fingers; this is followed by small lithotomy-forceps, and the stone is slowly extracted. Some laceration of the mucous membrane of the urethra is almost sure to occur, but the result of this proceeding is most satisfactory; the patient will experience no incontinence of urine or other ill-effect, and will probably be convalescent in a few days. But when the stone is of considerable magnitude, the surgeon has a choice of several methods of removal. He may adopt lithotrity with immediate removal of fragments by Bigelow's plan, if the stone is not larger than a strong ordinary lithotrite can deal with, say up to an ounce and a half or two ounces. In favour of this proceeding is the fact, that the largest evacuating tube may be readily used with a little dilatation. Or the stone may be broken and removed piecemeal by small forceps: or he may make an incision upwards laterally on a grooved staff, dilate the neck of the bladder with his finger, and extract the stone entire.

Should the stone be still larger, say three ounces or more, the choice will lie between vaginal and supra-pubic incision. The former is certainly to be preferred to any plan of cutting the urethra, whether upwards or laterally, and dragging the stone through that passage; such a proceeding would almost certainly, with a stone of considerable size, lead to permanent incontinence and future misery; but it must be admitted that a vaginal incision, combined with the force necessary to extract a large stone, may lead either to permanent vesico-vaginal fistula or to the necessity of repeated operations for its closure. The supra-pubic operation conducted after Petersen's method offers the most tempting inducement; it is not difficult of execution, it entails no liability to incontinence, and the free drainage of the bladder by the urethra is easy. The one cause for hesitation is the possible risk to life from peritonitis or urinary infiltration which this operation may entail, and this risk there are, at present, no means of accurately estimating. Experience alone can decide the question. In children, however, when the stone is full-sized, the supra-pubic operation should surely be preferred; the small and undeveloped urethra and vagina, the abdominal position of the bladder in the young, and the comparative immunity of children from urinary infiltration, are considerations which may well lead to its adoption.

It should be borne in mind that, in young women, the presence of stone in the bladder is generally due to incrustation on some foreign body introduced by the patient, and this may produce some difficulty in, and require some special method for, its removal. Another point connected with stone in the female may be mentioned—viz. the spontaneous expulsion of even large calculi from the bladder. This has been quoted to prove how dilatable the urethra must be (*see* paper by Bryant, *Medico-Chir. Trans.*, vol. xlvii. p. 151). In the Norwich Hospital Museum is a large stone which dropped from a woman without any operation or effort on her part: it weighed six ounces. There is no history of the case, but there is reason to believe that in this, and in some of the instances given by Mr. Bryant, there was first a prolapse of the vesical wall into the vagina, then the continued straining efforts of the bladder increased the prolapse, and that, finally, ulceration and liberation of the stone took place. The writer saw one such case many years ago, in which a full-sized stone had caused such a falling of the bladder and upper wall of the vagina that it presented as a round mass at the os externum, and had been mistaken for prolapsus uteri.

The Results of Lithotomy may and should be regarded from two points of view—1, the mortality; 2, the tendency to recurrence of stone.

(1) *Mortality after Lithotomy.*—The value of mere statistics is small, but they may justify approximate estimates on some points which will serve for guidance in practice. Those of the Norwich Hospital only will be used, partly because they consist of a compact body of cases of large number and done on some uniform system; and also because there exists in the hospital museum, not only a record of the chief facts of every case of lithotomy and lithotrity from the commencement of the hospital up to the end of 1884, just a hundred years, but the calculi also are there, cut and labelled, and well displayed to prove the accuracy of the record.

The whole number of operations amounts to 1,245. Of these, 1,124 were by lithotomy and 121 by lithotrity.

Of the 1,124 lithotomy cases, 1,074 were males and 50 were females.

Of the 1,074 males, 927 recovered and 147 died, being about 1 in $7\frac{1}{3}$, or $13\frac{1}{3}$ per cent. Of the 50 females, 46 recovered and 4 died, being about 1 in 12, or 8 per cent.

Age, of course, influenced greatly the results. Thus, there were 513 cases under twenty, of which 475 recovered and 38 died, being about 1 in 14, or 8 per cent.; and 562 were over twenty, of which 456 recovered and 106 died, being 1 in 5·3, or about 19 per cent.

Of the adult males it may be further said, there were 465 over forty, of whom 349 recovered and 116 died, being 1 in 4, or 25 per cent.; while there were 169 over fifty, of whom 123 recovered and 46 died, being 1 in 3·67, or 27·4 per cent.

Weight of stone, again, affected results; thus, there were 794 cases in which the weight was 1 oz. and under, of which 723 recovered and 71 died, being 1 in 11·2, or 9 per cent.; of 1 oz. to 2 oz., 193, of which 159 recovered and 34 died, being 1 in 5·6, or 17·6 per cent.; of 2 oz. to 3 oz., 55, of which 35 recovered and 20 died; of 3 oz. to 4 oz., 14, of which 5 recovered and 9 died; of 4 oz. to 5 oz., 9, of which 6 recovered and 3 died; of 5 oz. to 6 oz., 3, of which 1 recovered and 2 died; of 6 oz. to 7 oz., 2, of which both died; of 7 oz. to 8 oz., 2, of which 1 recovered and 1 died.

Of the 151 fatal cases, males and females, the average age was forty-six, and the average weight of stone 840 grains. Of the 151 cases, 38 were under twenty, with an average weight of stone of 424 grains, and 113 were over twenty, with an average weight of stone of 1,122 grains, or 2½ oz.

(2) *Recurrence of Stone after Lithotomy* is comparatively rare. During the century of work at the Norwich Hospital, and out of about 1,030 individuals who were cut, only 40 were operated on a second time, and 5 a third time. It may be said that 150 of this number died, and could not, therefore, have had recurrence, and that many who had once experienced the agony of lithotomy would not have had courage enough to face it again; this would, however, only apply to pre-anæsthetic times, whereas since the use of ether recurrence is still rare. The causes of recurrence are (1) the descent of a fresh renal stone, and (2) the leaving of stones or fragments of stones at the first operation. A careful examination in the museum shows that, of the 45 individuals who had recurrence, in 21 the stone was broken at the operation, and in 14 there were multiple stones; and, further, that the interval between the first and second operation was far less in these 35 cases of multiple or broken stone than in the other 10 cases, where only one unbroken stone was removed. The inference is strong, almost amounting to proof, that, in a large majority of instances, recurrence of stone after lithotomy is due to stones or portions of stone having been left at the first operation.

William Cadge.

LITHOTRITY.—Since the first introduction of lithotrity sixty years ago, its progress and development have been steady and continuous. Civiale and Leroy-d'Etiolles in France, and Brodie in England, were mainly instrumental in establishing it as the proper rule of practice for stones of moderate size. Brodie's article in the *Medico-Chirurgical Trans.*, vol. xxxviii., is a model of lucid treatment of the whole subject; in it he reports the results of upwards of a hundred cases, setting forth with admirable candour his failures even more prominently than his successes; indeed, his clear exposition has left but little for his followers to do, except in the way of slight modifications of instruments and details of procedure. In both these particulars, however, improvement has gone on, and it has been illustrated in the work and writings of the Coulsons, and especially of Sir H. Thompson, whose name and fame are bound up with recent lithotrity. Five years ago it seemed as if, both as to its principles and method, the operation might be considered almost perfect; but in 1878 Professor Bigelow, of Harvard University, recognising the importance of the full dilatability of the urethra as demonstrated by Otis, and recognising, too, the value of Sir P. Crampton's and Clover's plans of extracting calculous débris from the bladder by suction, applied these observations to lithotrity, with the result that in his hands the operation has taken a new departure, based on principles wholly different from those which all surgeons up to that time had advised and adopted.

Thus, the old rules of practice were: repeated short sittings, the smallest possible use of instruments, and leaving the extrusion of débris as much as practicable to nature. Bigelow, on the other hand, maintains that the bladder is less hurt by the prolonged use of smooth metallic instruments than by the presence of sharp, angular fragments of stone; he therefore removes the entire calculus at one long sitting, even of one, two, or three hours' duration, if necessary, by suction through a large evacuating tube. He, aided by Otis, Keyes, Van Buren, and others in the United States, has proved the value and correctness of these principles by successful practice; he has demonstrated the method of operating in Europe, and after a short period of hesitating and somewhat reluctant assent, the plan has been almost universally adopted, and the old mode by repeated sittings is becoming obsolete. 'Litholapaxy,' as the new method is termed, has been applied to larger and larger stones, and its capability in this direction is not yet determined.

The instruments required are : (1) lithotrites of various sizes ; (2) evacuating tubes ; (3) an aspirator. Lithotrites are of two kinds, fenestrated and non-fenestrated. The female blade of the former should be somewhat flattened, and the prehensile surface slightly grooved or roughened, so as to hold the stone when seized. The male blade should be serrated and fit accurately. In the non-fenestrated instrument the female blade should also have its edges roughened, and there should be an opening in it for the lower half of its length, into which a projection on the male blade will fit. The object of this is to diminish the risk of over-impaction, but it will not prevent it altogether, for the upper half of the female blade may be over-packed with débris, and there are no means of freeing that part. Still, it is at the heel or junction of the blade and shaft that impaction is most likely to occur, and the larger opening mentioned will to a certain extent prevent it. The male blade should be serrated, wedge-shaped, and of less width than the female blade, so that the mucous membrane may not be easily caught. The handles of all lithotrites should be cylindrical or hexagonal in shape, with a sliding button to put the screw into immediate action. Sometimes the screw will not easily adapt itself, but will catch on the edge of the worm ; this, however, is obviated by giving a slight turn to the ring on the male blade, when the screw will slip home and adapt itself instantly.

The evacuating catheters or tubes are slightly curved or straight : the curved are easiest to introduce, the straight are the best evacuators. Bigelow prefers the straight ones, and Otis has suggested that the extreme end beyond the aperture should be slightly turned up, so as to facilitate its passage. These tubes are usually made in three sizes, equal to 14, 16, and 18 English scale. Each should be fitted with a gum-elastic bougie, which passes the whole length of the tube and partially fills up the lower aperture, thus rendering its journey to the bladder easier, and serving also to clear it of impacted fragments when necessary. Aspirators, made of stout india-rubber, are of various shapes ; they all have a funnel and stopcock at the top. Some have a glass trap or receiver at the lower end, into which the fragments fall, and the evacuating tube fits into the centre of the bottle ; in others, the glass receiver is separate from the bottle and intermediately placed between it and the evacuator. The latter is provided with a hanging wire valve, which is necessary to prevent the regurgitation of débris into the bladder. The evacuator is connected with the receiver or aspirator by a short tube fitted with a stopcock, or simply by a piece of rubber tube three or four inches long, which has the advantage, by its flexibility, of preventing any disturbance of the catheter in the bladder by slight movements of the aspirator. Bigelow has contrived a frame to sustain the apparatus and stand on the bed, and Otis has lately introduced an aspirator, by which the water is forced into the bladder by air-pressure from a separate rubber bottle. It is probable that, as time goes on, other modifications and improvements will be made ; at present none of the aspirators are perfect.

Before proceeding to the operation, it is important to ascertain, as far as possible, that the patient is in the most favourable condition ; that by rest and careful preparation the whole urinary tract and organs are in a quiet and satisfactory state. It is not necessary or desirable to accustom the urethra to the repeated passage of instruments. A clear estimate of the size and nature of the stone and of the prostate will have been ascertained by the sound, or possibly by the lithotrite. Also, the surgeon will have informed himself of the kind of bladder he has to deal with, as to its irritability, its capacity, its shape, hardness, or roughness, and any feature of peculiarity about it. It is not necessary at the time of operation to inject water into the bladder, as used to be done ; but it is well that there should be some urine in it, say the secretion of an hour or two, or as much as can comfortably be borne. The patient should lie on a firm mattress with a cushion beneath the buttocks, and the head low ; the knees slightly raised, well separated, and each leg steadied by a nurse or assistant ; the chest, body, and limbs should be well covered with blankets, so as to prevent exposure to chill during a proceeding which may be long. An anæsthetic is absolutely necessary in one-sitting lithotrity : in all cases it facilitates the use and manipulation of instruments, and especially in the deliberate and careful search for final fragments.

Operation.—The surgeon, standing on the patient's right side so close that he has not to reach or stoop much, and with his instruments within easy reach, insinuates the lithotrite along the urethra ; it matters little how this is done, so far as the penile portion is concerned. Generally the instrument should be parallel with one groin or the abdomen ; but when the triangular ligament is reached the hand must be raised to the perpendicular, and the point of the blades coaxed through this part by a manœuvre, difficult to describe in words and not always easy to execute. If any hesitation should occur, no force is to be applied, and it is useless to lower the handle prematurely as if the prostate had been reached; rather, the hand should be dropped towards the abdomen, and fresh gentle attempts made, varying the direction slightly. When this point is passed, the handle is gradually lowered towards the bed, and the instrument will slip on into the bladder almost by its own weight. If the prostate is enlarged, some little pressure and a very slight rotatory movement of the lithotrite may be required to carry it on, and the handle still further lowered so as to lift the blades over any obstacle at the vesical orifice.

When fairly in the bladder, the handle of the lithotrite should be somewhat raised, and the blades made to depress slightly the lower and back part of the bladder, and opened fully. By this simple manœuvre the stone will generally fall towards the instrument, and will be caught when the male blade is pushed down, care being taken not to raise the female blade out of its position. If the stone be not seized, the instrument may be turned to one or other side, or it may be wholly reversed and the stone picked out from behind the prostate. In doing this, care is required to avoid pinching the mucous membrane, and the closing of the blades should be slow and gentle. It is not always easy to distinguish between a piece of soft stone, enveloped in concrete mucus, and the lining membrane of the bladder. In this and in any case, before applying pressure either with the hand or screw, the blades with the stone should be turned up into the centre of the bladder. When once the stone is fairly seized and broken, the operator will have little difficulty in rapidly picking up pieces, and he should endeavour to attack the larger ones so as in a short time to produce good fragmentation.

This being done, the evacuating tube is substituted for the lithotrite, the same precautions in its introduction being required as for the lithotrite. If the stone is of small or moderate size, No. 14 or 16 tube will suffice, but if it be large, No. 18 possesses great advantages in the rapidity of removing débris. It is not necessary at each pressure of the aspirator to introduce much water; short and quick strokes give the best results. If the rubber bottle will not expand readily, a fragment of stone or clot of blood is probably impacted, and may be returned to the bladder by a sharp pressure of the bottle, or, if necessary, by disconnecting it, and freeing the tube by the gum-elastic plug. Sometimes, while the aspirator is extracting the water, the bladder may be felt to strike the end of the catheter with a vibratile thud. This should not be; it is a sign that the bladder is too empty; it is apt to be injured in its lining membrane, and it interferes with the free escape of detritus. It is easy to introduce a little more water, and then proceed. Care should be taken, when the instruments are changed, to leave four or five ounces of water, and not to use the lithotrite in an empty bladder. The thud, just mentioned, will easily be distinguished from the sharp click of fragments of stone, as they are drawn against the opening in the catheter by the out-rushing stream; this sound will cease as the fragments diminish. When débris cease to fall into the trap, the lithotrite is again used, the fragments reduced in size and evacuated as before, and so on alternately until no more stone can be felt or obtained.

In all these proceedings gentleness and care are necessary; the operator will change his lithotrites from a large and fenestrated one at first to a smaller and non-fenestrated one as the stone diminishes in bulk. The former never clogs; the latter pulverises fragments best, and renders their extraction easy and swift. Should the orifice of the urethra be too small to admit the evacuating tube which the size of the stone renders it proper to use, say 16 or 18, it may rightly be divided by a straight, narrow probe-ended knife for about half an inch alongside the preputial frænum. No other part of the urethra will oppose its passage, unless the prostate is awkwardly enlarged, and this will seldom obstruct it. It is desirable to remove the last fragment; and every experienced lithotritist knows how difficult this may be, for, after operating for some little time, these final small pieces are prone to get hidden in the recesses of the bladder, or to be enveloped in small clots of blood or thick mucus, and so escape detection. It is not right, however, to persevere or prolong the manipulation too much in searching for them. They will probably be expelled in a day or two, or they can easily be removed at a second sitting. So, too, although this method is called 'one sitting,' circumstances connected with the general condition of the patient or the state of the bladder may oblige the surgeon, however unwilling he may be, to desist and divide the treatment into two or more sittings.

At the termination of the operation the patient is warmly covered; hot dry flannels are applied to the perineum and above the pubes, and a morphia suppository placed in the rectum. Warm diluent drinks, such as barley-water or lemonade, are freely supplied, and a milk diet prescribed for a few days. Many patients are almost well at once and have no after-trouble whatever; others experience cystitis, more or less acute, and some require the catheter for a time to deal with retention. If much muco-purulent secretion accompanies this condition, or is present without retention and does not speedily abate, the bladder should be carefully washed out twice a day, or oftener, with warm boracic water or a weak solution of nitrate of silver. The strength of this solution will vary with each case; it is well to begin with a grain to three ounces of distilled water, but not infrequently as much as four to six grains to the ounce is beneficial. Rigors are proverbially common in all bladder cases requiring the use of instruments; frequently they simply mean a slight nervous shock, are evanescent, and do no harm. Sometimes they usher in cystitis; sometimes, too, they are the forerunners of grave, continued, and even fatal nephritis. Not infrequently, however, kidney-inflammation comes on without rigor, pain, or any bladder-complication. The patient becomes mildly febrile, complains of no pain, but he loses appetite and strength, fades away, and dies in the course of two or three weeks. The necropsy reveals pyelitis, dilated ureters, and hyperæmia, with or without scattered abscesses of the kidney.

Another complication, usually fatal, but happily rare after lithotrity, is suppression of urine. This may be looked for when the patient is known to have been subject to ordinary albuminuria; also in cases of chronic kidney-disease, the result of slow and slight inflammatory conditions. These cases are very difficult to diagnose beforehand. The urine probably contains no blood, albumen, or casts; there is no anæmia, and the patient looks, probably, in fair health. Suspicion may, however, be entertained if there be a large secretion of limpid urine, non-albuminous, but of low specific gravity. Should death from suppression occur after lithotrity or lithotomy, the necropsy may display no hyperæmia, but simply a contracted kidney, with atrophy of the tubular and cortical structure, or possibly a dilated pelvis, but still with wasting of the secreting tissue. Calculus in the kidney not very infrequently co-exists with stone in the bladder; its presence would be suspected if there were persistent aching over one kidney, but as often as not there are no diagnostic signs, and its presence is only revealed after death, when it has led to some of the fatal symptoms above described.

Treatment has but little control over these formidable renal complications, when they arise after lithotrity. The prompt removal of all remains of stone, frequent washing of the bladder with antiseptic fluids if there be fœtid urine and muco-purulent deposit, perfect rest, good sustaining diet, rubefacient applications to the loins, quinine, and moderate use of opium in some form if absolutely requisite: these means may sometimes ward off the worst symptoms, and facilitate recovery.

The Old Method of Lithotrity may still be preferred in certain cases; it requires perhaps less skill than the new, and the young surgeon may therefore be well justified in preferring it. In ordinary cases there is but little difference in the results. Even in the most experienced hands, the mortality of the one-sitting method would appear to be only one to two per cent. less than the old method, and in inexperienced hands it would very likely be greater. The old plan is gentler, milder, less formidable altogether; no anæsthetic probably is required, no extra assistance; the surgeon calls by himself and makes a short sitting, just as much as the patient is willing to bear, or it may be that the patient even calls on the surgeon when only a fragment or two have to be dealt with. A nervous, timid patient may prefer this to the more heroic and rougher, if more expeditious, proceeding. The writer, although fully admitting the many advantages of the new operation for the large majority of cases, has yet allowed himself to follow the old lines occasionally, and he is not dissatisfied with the result.

The first sitting should be conducted with great care, the stone being taken up and broken only four or five times. The patient should remain in bed for at least a day or two, during which time he will void water while recumbent. Some little cystitis will probably ensue, but frequently the sharp pains of stone abate at once and before any of it is passed. In a few days the sitting will be repeated, and the surgeon will soon form an opinion as to how much instrumentation his patient can bear. If the expelling power of the bladder be deficient, or the prostate be enlarged, in all probability the passage o débris will be slow, and only the finest will escape. Under these circumstances, its removal should be secured either by the repeated use of the non-fenestrated lithotrite, sometimes six or eight, or even ten times, in as many minutes, at each sitting, by which a large quantity is soon withdrawn; or by the application of the evacuating catheter and aspirator at once. The number of sittings required will vary according to the size of the stone, and the facility and rapidity with which the fragments are voided. From three to six is the average; but the writer observes in his list of cases one of seventeen sittings for 360 grains, and another of twenty sittings for 384 grains of dried débris. Both these cases, however, would now undoubtedly be treated by the new method. The last fragment is still the difficulty, and it should be the surgeon's most anxious care, by searching and re-searching, with sound, or lithotrite, or evacuator, to secure its removal; he will narrowly watch the patient's sensations, and if any, the least, of the old feeling at the glans penis or at the prostate should persist, he will not allow him to return home so long as a doubt exists.

The after-treatment is the same in both kinds of operation, but this may be added. Sitting should follow sitting without unnecessary delay, probably within three or four days. After the first crushing, however, should mild cystitis occur, a few days or a week of rest and treatment may elapse; but if the condition shows a tendency to run on, especially if it be associated with fetid urine and febrile persistence, the sitting should be promptly repeated, and if possible the entire stone removed at once by the evacuator. Should the use of the lithotrite at or after the first sitting prove to be very difficult or ineffective, and the vesical tenesmus and constitutional disturbance very severe and unsafe, the surgeon will be justified in at once clearing the bladder and putting it at rest by lithotomy. The writer has never yet thought it necessary to adopt this alternative, but he is inclined to admit, on reflection, that, in a few cases, the patients might possibly have been saved by its timely performance.

Foreign bodies have occasionally to be removed from the bladder; they are of great variety, and may require either lithotomy or lithotrity. *See* FOREIGN BODIES IN THE BLADDER.

The Obstacles met with in lithotrity may be due (1) to the size and nature of the stone; (2) to stricture of the urethra; (3) to enlarged prostate; (4) to atony of the bladder; (5) to sacculation of and other changes in the bladder.

(1) The mere weight and bulk of stone are no test of the difficulty of crushing. A stone weighing an ounce, composed of pure lithic acid, will, from its intense hardness, test the quality of the instrument and the strength of wrist more than one of double the weight, composed of phosphates or some of the salts of uric acid. The writer has sometimes trembled for his instruments when dealing with these pure red lithic stones; they break into sharp, angular pieces, very different from the laminated, smaller, fawn-coloured, and often multiple stones, composed of lithate of ammonia, which are, perhaps, in Norfolk at all events, the most common variety after the pure lithic. The oxalate of lime stone is also very hard, but it breaks into less angular pieces than the lithic. Litholapaxy, however, has accomplished the removal of lithic acid and oxalate of lime stones of two and even three ounces and upwards, and it may perhaps be said that, given a healthy bladder and prostate, a capacious urethra, and an experienced hand, the only limit as to size of stone is the power of the lithotrite.

(2) Stricture of the urethra, if slight and capable of full dilatation, need be no bar to lithotrity for stones of moderate dimensions; but in old stricture, with great surrounding induration and fistulæ, lithotomy will obtain the surest and most permanent cure. Sometimes a stone is detected in the urethra behind the stricture, as well as one or more in the bladder, or it may be partly in the bladder and partly in the urethra, and in these cases median lithotomy will not only remove the stone, but may go far to remedy the stricture by external division.

(3) Hypertrophy of the prostate gland is not necessarily a serious impediment to lithotrity; but, if it is considerable, it may impede the easy introduction of instruments, make the seizure of the stone difficult, the expulsion of débris slow and tedious, and in the one-sitting method obstruct the free and efficient action of the evacuator. Prostatic enlargement, also, leads to alterations in the shape and condition of the bladder, which deserve more attention with reference to lithotrity than they have hitherto received. Coming on as it usually does about or after the age of sixty, when the vital power begins to wane, it induces, by the obstacle it offers to the free escape of urine, dilatation and hypertrophy of the muscular walls of the bladder, and leads to imperfect contraction, residual urine, and,

worse than all, to sacculation of the mucous membrane in all its degrees. Enlargement of the median lobe, when it is considerable, projects backwards into the cavity of the bladder in such a manner as to form pouches or cornua on each side of it, and even below it, into which portions of stone may and do get, and where it is almost impossible for any instrument to follow and seize, or even detect them. Injections will not always wash them out of these recesses, especially when they are immersed in viscid adhesive mucus or blood-clot; they are probably overlooked, and may account for some of those numerous recurrences of stone which lithotritists have to lament.

(4) Atony of the bladder, from whatever cause, is a serious drawback to lithotrity, chiefly because, as the natural expulsive power is lost, the surgeon must trust to his instruments to remove the final, minute atoms of stone; and this is a matter of no small difficulty in flabby, reticulated, and irregularly-shaped bladders.

(5) Sacculation of the bladder is also an enemy to complete and permanent cure by lithotrity. The formation of these sacculi, from the slight honeycomb recesses between the hypertrophied columns to the complete sac, in which the mucous membrane is forced gradually between and through the muscular fibres and may equal the bladder in size, is well understood. The aperture of communication with these complete sacs is usually closed by the contraction of the muscular columns, so that a stone may be broken and none of the fragments may enter them; but, on the other hand, débris does sometimes find its way into them or one of them. The surgeon is unaware of it, and the patient, being relieved of nearly all his suffering, is probably declared to be cured. But trouble is in store for him: gradually an encysted stone is formed; it enlarges and grows up into the bladder; pain and cystitis return, and all the surgeon can do is, from time to time to break off and remove the projecting portion; or he may do lithotomy, with the slight hope of being able to dislodge the whole stone from its bed. Sacculation, too, may lead to another serious danger in lithotrity—viz. to peritonitis. In two fatal cases, the writer found after death acute peritonitis, apparently originating in large sacs, the walls of which consisted of mucous membrane only covered by peritoneum, and were in a sloughy condition; the inflammation was probably due to decomposing urine imprisoned in the sacs; the fœtid character of the urine was perhaps increased by the slight cystitis set up by the operation. In all cases of sacculation and stone, it is certain that the danger now pointed out would be diminished by the prompt and immediate removal of all the débris, and this constitutes another advantage of the one-sitting method.

The Dangers of Lithotrity are—(1) bleeding; (2) clogging of the lithotrite; (3) impaction of fragments in the urethra; (4) rupture of the bladder or urethra; (5) cystitis and nephritis.

(1) Bleeding is seldom a cause of trouble, but in a few recorded cases the bladder has become filled with clot and unable to relieve itself, and the patient has been brought into danger by both local and constitutional symptoms of a serious kind. In such a condition two courses are open for adoption—either to draw off the urine as it is secreted, by the frequent use of a full-sized catheter with a large eye, soothing the part and system, and leaving the clot to soften and come away by degrees; or the clot may be sucked out of the bladder by a strong syringe and a large catheter, alternately washing and exhausting until all is removed. The first method is generally preferable, but in either case troublesome cystitis is apt to follow.

(2) Extreme impaction of the lithotrite with débris can only occur with the non-fenestrated instrument; when it does happen, the operator should endeavour, by opening and closing the blades, and moving them about in the urine, to free them to some extent. Then he will try to withdraw the lithotrite: it will probably pass along the prostatic and membranous urethra, but it may be arrested either just behind or in front of the scrotum, and if by fair traction force it will not come away, it will be right to cut down on it in the perineum, turn out the blades and unload them, and then withdraw the instrument. If the opening in the urethra is far down in the perineum, it would be good practice to slip the finger back into the bladder, dilating the passage as it goes, and clear out all the stone as in a median lithotomy; or, if this is not done, a full-sized catheter should be introduced and retained in or near the bladder for a time, so that no fragments may pass until the wound is more or less closed, and if possible no urine should be allowed to irritate it. This accident has only once occurred to the writer, with one of Charrière's instruments. It was withdrawn with some force, causing slight laceration of the mucous membrane; swelling followed, fragments of stone accumulated at the part injured, and led to a sloughy abscess, which

was opened, and allowed all the stone to escape. The patient recovered, but a permanent fistula, close in front of the scrotum, remained. Even when the instrument is not over full, it is apt to scratch the urethral membrane with sharp fragments which project from the blades; it is seldom that this causes harm, but it is to be borne in mind as one of the disadvantages of the non-fenestrated lithotrite.

(3) Rupture of the bladder or urethra has undoubtedly occurred since the introduction of litholapaxy—of the bladder, presumably, by sudden over-distension, or by the point of the evacuating catheter; of the urethra, by the rough use of too large an instrument. Peritonitis in the one case, and urinary extravasation in the other, will befall the patient, and discredit will come upon the surgeon. It may be expected, however, that these mishaps will not be repeated now that the novelty of the operation has passed by.

(4) Arrest of fragments in the urethra occasionally occurs, and may produce total or partial retention of urine, pain, spasm, and distress. Very often, the natural efforts and pressure of the urine will accomplish the removal of the obstacle in a short time; if they do not, and the fragment is far back, it should be pushed into the bladder by a large catheter, open at the end so that it may better engage and hold the offending piece. When arrested nearer the meatus, it should be seized and withdrawn by long slender forceps or Civiale's urethral lithotrite. It is very seldom, indeed, that a fragment will require to be removed by external incision, but this may be called for.

(5) Ordinary cystitis and nephritis have been referred to already in describing the after-treatment; but there is a form of persistent chronic cystitis, accompanied with vesical irritability, decomposing urine, and phosphatic deposit, which all lithotritists admit to be not infrequently the sequence or consequence of the operation. It generally occurs in old and feeble persons in whom the prostate is hypertrophied, the bladder dilated and unable to empty itself, and therefore unable to expel all the débris of a broken stone. Hence, although by clearing out the main bulk of the stone the patient is greatly improved, some few atoms probably elude detection, and these, acting as nuclei, form the basis of future phosphatic concretions, and in a few months, or perhaps a year or two, the patient presents himself again and is again more or less cured. Sometimes the bladder, at this second intervention of the surgeon, is entirely freed of calculous matter, and by the careful use of the catheter and diligent washing out of the bladder no further recurrence takes place; but this happy result is rather the exception than the rule, and the surgeon must either go on repeatedly removing phosphatic matter with the lithotrite, or he must do lithotomy with the hope—the somewhat forlorn hope—that by entire clearance of stone, and by drainage and repose of the bladder for a time, a permanent cure may result. Some surgeons attribute this persistent chronic cystitis to the rough use of instruments, or to some inherent tendency to phosphatic deposit; but the writer believes that, in the great majority of such cases, it is due to leaving some trifling piece of stone undetected. The difficulty of finding and removing the last atom in some bladders has been alluded to. The hope has been expressed that by the aspirator and the large evacuating tube of the new method this may be more certainly accomplished than by the old method; but at present it is only a hope, and it is yet to be proved that recurrence of stone is less frequent now than it used to be. Stones of purely bladder origin and formation are rarely met with. In ordinary cases of atony and chronic cystitis, with decomposing urine loaded with muco-purulent deposit, stone will seldom occur unless there is a nucleus of some kind; and, when stone does occur in these cases, it will be found that they are almost always of renal origin, although the bulk of the stone may probably be composed of phosphates.

The Results of Lithotrity may, like those of lithotomy, be considered—(1) as to the mortality; (2) as to recurrence.

Taking again the experience of the Norwich Hospital, there have been 121 cases in 117 individuals with 13 deaths, being 1 in about 9½, or 10·7 per cent. The average age was just sixty, the average weight of stone preserved was 110 grains. In the 13 fatal cases the average weight of stone was 209 grains, showing that, as in lithotomy, the mortality increased with the increasing size of the stone.

The list of lithotrity cases recently reported by Sir H. Thompson affords, both from the large number and the brilliant success obtained, the best evidence of what lithotrity can achieve. He enumerates 672 cases in 576 adult males with 43 deaths, being 1 in 15½, or about 6 per cent. The average age was sixty; the weight of stone is not given, and this diminishes the interest and value of the record. He mentions, however, having crushed 100 stones which were so small as to produce only slight symptoms, and of which cases only one was fatal. In a valuable paper read by Sir H. Thompson at the International Medical Congress in 1881, he gives the weight of 75 cases done by Bigelow's method, the average being 130 grains, and in others the stone is described as 'small.'

Dr. Freyer, of the Indian Civil Service, has recently published (*Lancet*, February 28, 1885) a remarkable series of 108 cases in males above puberty, done by litholapaxy, with only 4 deaths, being 1 in 27 only, or 3·7 per cent.; the average age of the patients was forty-seven, and the average weight of stone 317 grains. Thus there were more young and probably healthy, and fewer old and probably unhealthy, persons than English lithotritists are accustomed to meet with; but the average size and weight of stones in Dr. Freyer's practice was undoubtedly great. The record indeed is the most remarkable and successful yet published, and testifies strongly to the skill of the operator as well as to the endurance of the Indian constitution.

Recurrence of Stone after Lithotrity is undoubtedly common; it constitutes the greatest drawback of the operation, and requires from the practical surgeon the most candid statement and the fullest inquiry. An analysis of Sir H. Thompson's cases would seem to show that of 576 adult males treated by lithotrity, 61 were operated on a second time, 9 a third time, 3 a fourth, and 2 a fifth time; or 75 out of 576, being 1 in 7·6, or 13 per cent. It is probable that not all who suffered from recurrence applied to him again; they may have gone elsewhere or declined further treatment. Moreover, there were 43 fatal cases, in none of which could recurrence have taken place. Further, this list of 75 only includes those which, Sir H. Thompson considered, deserve to be called 'stone,' and does not include those numerous ones of so-called phosphatic 'concretions,' which are due either to phosphatic deposit from decomposing urine in an incompetent bladder or to undetected fragments. If, therefore, this frequent recurrence of stone has occurred in the practice of one so skilful and of such vast experience, it must be admitted that, so far as it can be shown to be incident to the operation of lithotrity, it must be considered a great and serious drawback.

The causes of it are, as in lithotomy—(1) the descent of a fresh renal stone; and (2) the leaving of stones or fragments of stone at the first operation. The descent of a fresh stone from the kidney is obviously as likely to follow one operation as the other; there are not a few persons who are in the habit of voiding small stones composed of lithic acid or lithate of ammonia, and this habit may persist after some of these have been removed by operation. But when it is remembered that in lithotomy recurrence is almost certainly caused, in more than half the cases, by leaving stones or portions of stone at the first operation, and when it is remembered too that recurrence is vastly more frequent after lithotrity than after lithotomy, it cannot be denied that, in by far the larger number of cases of recurrence after lithotrity, the real true cause is the leaving of calculous débris in minute quantity at the first operation. The difficulty of removing these final atoms from the recesses and pockets of the atonic, half-paralysed bladders of aged and feeble persons has been referred to; the difficulty may, and probably will be, much lessened by the large evacuating tubes of Bigelow, but hitherto this drawback has been regarded as the price paid for the vastly greater security to life from lithotrity, as compared with lithotomy.

Choice of Operation.—This is a matter not infrequently of great nicety and difficulty, even to the most experienced surgeon. Indeed, as Sir W. Fergusson has said, the greater his experience, the greater will sometimes be his doubt. He will, in certain cases, dread, if he cannot clearly diagnose, those kidney-changes which may mar his best endeavours, and which the young surgeon is apt to think but little of; he will know, too, that even with a measuring sound it is not always safe to infer the exact size of a stone, for, in large, flattened stones, a small diameter may mislead him into the belief that he has one of a moderate size to deal with. There are some points, however, on which all surgeons are agreed. In children under puberty, unless the stone is very small indeed, lithotomy should be the rule; its good results in the young, and the small size of the urethra, which precludes the use of the evacuating tube, combine to favour the method of cure by one complete operation. On the other hand, in the healthy adult, lithotrity should undoubtedly be adopted in all cases where the stone is of moderate size; but it may be asked what is meant by the word 'moderate.' A different answer will be given now to that which used to be offered, for it is certain that litholapaxy is competent to deal with stones of considerable magnitude, even up to 2, 3, and 4 ounces. It should, however, be borne in mind that a single hard uric acid or oxalate of lime stone of 1½ or 2 oz. will be far more difficult to break and extract, and be more trying to the patient, than double that weight of small multiple or friable and laminated stones. Up to an ounce and a half in weight, there can be no doubt of the immense superiority of lithotrity over lithotomy, so far as mortality is concerned. Above that weight, say from 1½ to 3 ounces, it yet remains to be seen whether lithotrity by any method can be applied with more safety and success than lithotomy.

In the Norwich Hospital there have been 193 cases, chiefly adults, treated by lithotomy, in which the stones weighed 1 ounce and under 2, with 159 cures and 34 deaths, being 1 in 5·6, or 17·6 per cent.; and 55 cases of 2 ounces and under 3, with 35 cures and 20 deaths, being 1 in 2·75, or 36 per cent. These figures will serve as a basis for future comparison. In stones weighing more than three ounces the choice will rest between lateral and supra-pubic lithotomy; and here, again, experience, not at present forthcoming, is required to assist in deciding. In the same hospital there have been 50 cases, almost all done by the lateral method, of stones above 3 ounces, with 31 cures and 19 deaths, being 1 in 2·6, or 36 per cent. This list also will serve for future comparison. The writer has long felt that supra-pubic lithotomy deserves a full re-examination by the light of modern antiseptic surgery and the more perfect system of drainage; lately a fresh impetus has been given to this inquiry by the investigation of Professor Petersen. So that it would seem likely that in future, the time-honoured operation of lateral lithotomy will be shorn of its prestige and diminished in its supremacy by the extended domain of litholapaxy on the one hand, and of supra-pubic lithotomy on the other. In children of both sexes, with large stones, the high operation has been proved to have great advantages, and in adult females, when the stone is beyond the compass of lithotrity, the high operation will probably come to supplant the vaginal or any other method of cure.

These principles and rules dealing with stones of various sizes are applicable only or chiefly when the urinary organs are sound and the general health good; but what course should be adopted when these circumstances are adverse? The effect of stricture, of prostatic enlargement, of changes in the shape and walls of the bladder, have already been mentioned. Mere vesical irritability seldom impedes lithotrity, nor do atony and chronic cystitis; these bladders, as a rule, bear the contact of instruments well, and are frequently already accustomed to the constant use of the catheter. But what is to be said of stone, complicated with kidney disease, such as albuminuria, and chronic pyelitis, and atrophy? In these cases all operations are fraught with danger, but it is probable that the least risk will be met with from a carefully conducted one-sitting lithotrity. So, too, in those cases of constitutional disease combined with stone, such as diabetes, tabes, and other spinal diseases, it will be well to avoid the shock and hæmorrhage of lithotomy, and proceed, if any surgical proceeding is allowable, by lithotrity. This, however, can only be recommended in cases where the stone is of strictly moderate size; when it is of 1½ or 2 oz. and upwards, the lateral or high operation will probably afford the best of the bad chances of recovery. Some consideration in selecting the operation must be given to the tact and experience of the surgeon. A beginner will do well to adopt lithotomy in cases of full-sized stones in which his more experienced colleague would trust himself to do litholapaxy; but no one should adopt the latter without practising it well beforehand outside the bladder. Lastly, it may be said that by lithotomy there is greater danger to life, but a more perfect recovery for those who do recover; while by lithotrity the immediate security to life and the present recovery are not infrequently dearly purchased, and well-nigh counterbalanced, by the recurrence of the disease or the more or less permanent persistence of some form of vesical trouble.

William Cadge.

LITTRE'S OPERATION for opening the colon in the groin. *See* Atresia Ani.

LIVER, Rupture of the.—From its size the liver is more frequently ruptured than any of the other abdominal viscera. Either surface of the organ may be torn, but the upper is more frequently so affected, and an organ that is diseased is more prone to suffer than one of normal texture. Several degrees of rupture are met with, varying from a slight superficial crack to a complete pulp. The parenchymatous tissue may sometimes be torn while the peritoneal covering of the organ is left intact.

Causes.—Blows, falls, spent shot taking effect in the hepatic region, wheels of vehicles passing over the abdomen, fractured ribs perforating the diaphragm.

Symptoms.—As there are none that are strictly diagnostic, the presence of a communicating wound or the performance of laparotomy can alone lead to an accurate estimate. The precise nature of the injury and the region of the abdomen must be considered. Shock, if the rupture be of any extent, is well marked; the general surface of the body is pallid and cold; vomiting, thirst, general restlessness, sighing respirations and feeble pulse, are present; also pain and tenderness in the region of the liver; but this is likewise present when the organ is merely bruised. An increase in the faintness and feebleness of pulse denotes that the hæmorrhage is continuing, and that an accumulation is taking place in the peritoneal cavity, which will be recognised by a gradually widening area of dulness on percussion. If not speedily fatal, jaundice and itching of the skin may supervene. Should an external wound exist, bile may be discharged through it.

Prognosis.—This depends upon the size of the rupture. If it be of any magnitude, death takes place in a few hours from shock and hæmorrhage. Small ruptures may be recovered from, and very superficial cracks may pass undetected. If the immediate dangers be overcome, the subsequent ones that threaten are peritonitis and abscess due to the extravasation of blood and bile. When the serous covering of the organ is not torn, the chances of recovery are enhanced.

Treatment.—Rest in the horizontal position; warmth to the general surface of the body; hot fomentations or ice applied over the region of the liver. To relieve pain and tenderness, morphia should be administered subcutaneously or by suppository. Brandy, if it can be borne, should be administered by the mouth in frequent but small doses until the heat of the body is restored. To allay thirst, ice may be given to suck, and cold or warm water in teaspoonful doses.

If it be evident that the internal hæmorrhage is copious or continuing, the abdomen may be opened in the middle line between the ensiform cartilage and the umbilicus, the peritoneal cavity emptied of blood-clot or bile, and the wounded organ examined. Should exposure not restrain the hæmorrhage, the bleeding surface may be gently seared with the thermo-cautery; the abdominal cavity should then be washed out thoroughly with clean hot water and carefully dried with sponges. A glass drainage-tube having been inserted, the rest of the parietal wound should be closed and dry dressings applied, secured with strapping and a wide flannel bandage. The drainage-tube should be retained for at least twenty-four hours, and longer if the discharge be copious.

Peritonitis must be treated in the ordinary manner, and any abscess-formation should be evacuated by the aspirator or by incision. Thomas F. Chavasse.

LOCAL ANÆSTHESIA.—When we consider the fatal cases which have resulted from general anæsthetics of all kinds, and call to mind the fact that very many of the deaths have occurred in operations of trifling magnitude; when also we think of the unpleasant and sometimes dangerous after-effects of such anæsthetics, it is obvious that local means for the prevention of pain would be of the greatest value.

Although by squeezing and rubbing the lobe of the ear jewellers render it insensitive to the passage of a needle, the use of compression of sensory nerves may be said to have failed to produce sufficient anæsthesia to render even small operations painless. Narcotic drugs—opium, morphia, belladonna, chloroform, carbonic and carbolic acids—applied to the unbroken skin or injected hypodermically, are either too weak in their action to prevent the pain of a cut, or they produce painful effects such as vesication. But lotions, ointments, and vapours of the above drugs are valuable when applied to painful ulcers, simple or malignant.

Until quite recently, the only local method of preventing the pain of an operation was that of freezing the part. This may be done by—(1) the application of a mixture of ice and salt to the part, or (2) by the ether spray.

Ice and Salt.—Finely powdered ice and salt, well mixed in the proportion of 2 to 1, and put into a gauze bag, are closely applied to the part. In five to ten minutes the skin becomes yellowish-white, firmer than natural, looks tallowy on section and does not bleed, and incisions into it are painless. After a somewhat longer application a nail may be painlessly removed; but it is impossible to freeze deeper tissues without great probability of inducing sloughing.

The *ether spray* is handier than ice and salt. The nozzle should be held one to two inches from the part. In from half to two minutes, a white firmish patch appears and rapidly spreads. Painless incisions may now be made in the skin; but the deeper parts are unaffected. It has been recommended to play on the latter through the incision—to make the spray precede the knife; but this is a very slow process, and could not be carried out for large incisions. The knife, too, gets crusted with ice, and the operator's fingers numb. No cautery or light must ever be brought near the spray. *See* ETHER-SPRAY.

The first objection to both these methods is that their action is very superficial. But they cannot be recommended even for superficial operations, as the sensations in a part during freezing are painful; and, during thawing, the suffering may be so acute as considerably to exceed that which the operation itself would have caused. It is well, however, to bear in mind that a Cæsarean section has been done almost painlessly under the ether spray.

Hydrochlorate of Cocaine.—During the last few months this drug has been much used as a local anæsthetic. A solution of from 4 to 20 p.c. is either dropped or painted over the surface to be anæsthetised, two or three times at intervals of three to five minutes; sufficient anæsthesia is thus produced for the performance of small operations, and continues from ten to fifteen minutes. But the drug will not act through unbroken skin, and can, therefore, be used as above only upon mucous surfaces. Two cases have, however, been reported in which a hypodermic injection rendered the opening of an abscess painless. The new anæsthetic has been used chiefly in operations upon the eye, ear, nose, mouth, larynx, urethra, and rectum. Its capabilities are probably not yet fully determined.

STANLEY BOYD.

LOCK-JAW. *See* TETANUS.

LOOSE CARTILAGE.—This is the name given to certain movable bodies, of varying origin and constitution, which are found in the interior of joints, especially the knee, and whose presence gives rise to a characteristic train of symptoms.

The name 'loose cartilage' is, however, not always an accurate one; for these bodies are sometimes not loose, and frequently contain no cartilage. Most often they consist chiefly of fibrous tissue, in which is a small quantity of ill-formed cartilage containing some irregularly deposited calcareous material. They may, however, be formed of true cartilage, or of cartilage which has undergone a variable amount of ossification or calcification. Others consist of small masses of fibrinous lymph.

They may be single or multiple, and they vary in size from a quarter of an inch to an inch or more in diameter. The majority of these bodies lie loose in the joint, and can travel to any part of it; but occasionally they are attached by a pedicle which limits their range of movement. Their occurrence is almost confined to the knee, but they have occasionally been met with in the elbow, and rarely in some of the other joints. Their mode of origin is variable, though they are often traced to injury. Probably, many of them occur in the early stages of osteo-arthritis, in which cartilaginous or calcareous material is formed in a synovial fringe, and this, becoming pendulous, is eventually detached either by injury or the movements of the joint. Or, they may have their origin in the exudation of inflammatory lymph upon the surface or into the substance of the loose synovial tissue; and this, undergoing development into fibrous tissue or cartilage, is separated from its attachment by the pressure of the bones. In other cases, a piece of the articular cartilage is detached either by direct injury or by the process of necrosis.

The *symptoms*, caused by the presence of a loose body in a joint, are recurrent attacks of pain and synovitis. The pain comes on suddenly and is very acute; it is due to the body slipping between the ends of the bones. In the knee (which is the only joint that need be considered), when this occurs the joint becomes immediately fixed, and this, together with the severe pain, often causes the patient to fall. After a time, usually a few hours, or it may be in the first effort to move, the loose body again becomes displaced and the joint can be moved; but more or less synovitis ensues. These attacks of pain and synovitis recur whenever the loose body becomes caught between the bones, and, as every attack of synovitis leaves the joint a little looser, this occurrence is apt to become increasingly frequent.

Treatment.—This must depend upon the amount of inconvenience caused by the presence of the loose cartilage, and also upon the condition of the health of the sufferer. In some cases, a carefully contrived splint or bandage will keep the offending body in the upper pouch of the synovial cavity, where it may possibly become fixed by adhesions. Or, the same end may be attained by the use of strapping over it a piece of leather, with a hole cut in it to receive the loose body. But usually such measures are inefficient, and the patient requires something more radical to be done. The only curative treatment is the removal of the loose body from the cavity of the joint. This, of course, can only be done by opening the joint, which, even with every precaution, is an operation of sufficient gravity to forbid its being undertaken till palliative measures have been tried. Moreover, it is to be remembered that any serious disturbance of the patient's health, and especially such as is indicated by the presence of albumen in the urine, should deter the surgeon from any avoidable operation upon a large joint. Nevertheless, if the local inconvenience renders the extraction of the loose cartilage desirable, and the patient be in good health, the operation may be undertaken with every prospect of success.

Two methods of operation are available: one in which an incision is made directly into the joint, and the loose body at once removed; the other in which, the capsule of the joint being opened subcutaneously by a long knife passed obliquely under the skin, the loose body is pressed out of the joint into the subcutaneous cellular tissue, and either left there or removed after the wound into the joint is healed. Whichever operation is adopted, the strictest antiseptic precautions should be observed; and, if due care be taken on this point, the removal of the loose body by direct incision is, in the writer's opinion, the preferable method.

If the loose body be freely movable, an incision a finger's breath in length should be made on the outer side of the joint, the loose body if possible being held in that position, and then squeezed through the opening. Should the substance slip away, as often happens, the finger may be introduced into the joint to bring it again towards the opening, through which it may be extracted by a small pair of lithotomy forceps. If there be any difficulty, it is much better to explore the joint with the finger than to search for it from the outside or by movements of the joint. The wound is to be closed by a fine catgut suture, antiseptic dressings applied, and the limb at once fixed on a splint.

Usually, there is no local or constitutional disturbance; the wound is healed in a few days, and after a fortnight's rest of the limb the patient may be considered well. Should there ensue any inflammation of the joint, it must at once be combated by decided antiphlogistic treatment.

J. Warrington Haward.

LORDOSIS. *See* Antero-posterior Spinal Curvature.

LUMBAR ABSCESS.—An abscess, usually chronic, situated in the loin or over the lower ribs near their angles.

Cause.—Generally due to caries either of the spine or ribs; may also come from deeper parts, as the kidney, or may have no evident source of origin; this last occurs usually in children, and is subcutaneous. In children, also, acute abscess in the erector spinæ, without bone-disease, is seen.

Pathology.—When from spinal caries, it may be a diverticulum in the course of a psoas abscess, starting at the upper or lower end of the primary abscess; and, when the former, it lies over the lower ribs, and may be mistaken for a localised empyema. Or pus may travel directly backwards from the spine to the outer edge of the erector spinæ; or, more rarely, may be over the spines themselves; or, passing between the laminæ, may get into the sheath of the erector spinæ; or a dorsal spinal abscess may travel down and become lumbar. Caries of the lower ribs or of the iliac crest may also cause lumbar abscess; and a pyonephrosis and perinephritic abscess may project in the loin, as well as in the abdomen.

Symptoms.—No special subjective symptom belongs to lumbar abscess; the tumour is generally the first thing remarked. Any source of origin, as above, must be sought for; the deep connection of the swelling is shown by a cough impulse.

Diagnosis.—The abscess is recognised by the usual physical signs; its origin must be discovered by history and examination. The possibility of its being part of a psoas abscess must not be forgotten. When over the lower ribs it may be an empyema, which an examination of the thorax will decide; or it may be from rib-caries. Until the abscess is opened, it is usually impossible to feel any carious or irregular surface. A local spot of pain under the abscess and in the rib suggests caries. The 'cold' subcutaneous abscess of children has only negative signs with regard to origin. Pyonephrosis and perinephritic abscess cause abdominal swelling as well, and probably pyuria. Renal cancer resembles lumbar abscess at times, but there is no true fluctuation; there are great pain and special renal symptoms—e.g. hæmaturia.

Treatment.—Whether due to caries or not, the abscess must be opened freely; this allows exploration and perhaps removal of sequestra. In the subcutaneous abscess of children, relief of tension by aspiration, followed by firm bandaging over belladonna plaster, with the internal use of iodide of iron, frequently causes resolution of the abscess.

C. Hilton Golding-Bird.

LUMBAR HERNIA.—In this variety of hernia, the protrusion presents itself externally in Petit's triangle. This triangle is bounded in front by the external oblique, and behind by the latissimus dorsi, while its base is formed by that part of the iliac crest which lies between the attachments of the two muscles. To reach the triangle, the hernial sac passes through the posterior aponeurosis of the transversalis muscle, and then through the fibres of the internal oblique. Its neck will be situated near the outer border of the quadratus lumborum. This rupture has occurred most usually after wounds, deep abscesses, and severe contusions. It is also said to have followed pregnancy and ascites. The sac may contain small intestine or omentum, or a portion of the ascending or of the descending colon. The hernial tumour is usually very small, but it may attain the size of an infant's head. It is reported to be usually oval in shape, with its long axis placed antero-posteriorly. Its orifice is large; and it is as a rule readily reduced. It may, however, become irreducible or inflamed. It has been the seat of strangulation, and in one reported case of strangulation herniotomy was performed, but with a fatal result. The hernia has been mistaken for lumbar abscess, for hæmatoma, and for a fatty or fibro-cellular growth.

Frederick Treves.

LUNG, Hernia of the. *See* Pneumocele.

LUNG, Inflammation of the. *See* Pneumonia, Traumatic.

LUNG, Wounds of the.—These may be produced in three ways—

(*a*) By an external agent, as in stabs.

(*β*) By the fractured end of a rib.

(*γ*) Certain rare cases occur in which the lung ruptures in compression of the chest, where no rib-fracture can be detected.

Wounds of the lung are also divided into punctured, lacerated, and incised wounds. Of these, the incised wounds are the most dangerous, being attended with the most copious hæmorrhage. A punctured wound is the least dangerous, as may be illustrated by the effect of an accidental puncture in exploration of the chest with the aspirating needle. A lacerated wound, such as that caused by a fractured bone, will be dangerous in proportion to the amount of tissue involved.

Diagnosis.—(*a*) Where there is an external wound, blood and bubbles of air may be seen in some cases escaping from the opening in the act of respiration, or even passing backwards and forwards by an efflux and reflux movement. If the wound in the chest be large, there may be a hernia of the wounded lung (pneumocele). In such cases (which are, however, rare), the diagnosis is easy, but in the majority a wounded lung must be diagnosed inferentially from the state of the chest and other symptoms. On account of its vascularity, hæmorrhage from a wound in the lung is one of its most common accompaniments. This takes place into the cavity of the pleura (hæmothorax), and into the lung-tissue about the site of the wound. Comparatively seldom does this hæmorrhage take place to any great extent externally, unless the wound be very large. The elasticity of the tissues, and consequent tendency of a small wound to close, will, as a rule, shut in the blood, and the hæmorrhage thus takes place internally. Internal hæmorrhage, whether into pleura or lung, gives rise to dulness about the affected side, more especially about the base of the lung, if the amount of extravasated blood be considerable. The area of dulness, however, depends a good deal upon the position which the patient assumes after the injury is inflicted. If, as is most common, it be the recumbent posture, the blood will not necessarily gravitate towards the base of the lung, and the area of dulness will be most marked about that part of the chest upon which the patient has principally lain.

The *amount* of blood extravasated is not generally great enough to cause any considerable compression of the lung, unless some very large vessel has been wounded; but it is often enough to separate completely the surfaces of the pleura. Fine crepitation is the auscultatory sound most commonly present. But if the amount of blood extravasated be large, the crepitation will disappear, and the breathing sounds become indistinct or inaudible from the lung-tissue having become compressed. The very rapid appearance of the dulness after the injury will enable the surgeon to distinguish it from acute pleuritic effusion.

Other signs of wounded lung consist in:—

1. A fixed, deep, and severe pain in the thorax about the region of the wound.

2. Much troublesome cough, with irritation of the larynx, causing constant desire to cough. The patient, however, is obliged to repress the tendency within the narrowest possible limits on account of the increase of pain so caused, and thus arises the peculiar, small, *suppressed* cough of thoracic injury.

3. Very considerable dyspnœa. This no doubt arises from, and is directly proportioned to, the amount of lung-tissue rendered inoperative by the injury.

4. Hæmoptysis. Frothy blood is coughed up from the chest into the mouth in this condition; at a later stage, as the pneumonic state supervenes, the frothy blood gradually gives place to rust-coloured sputum.

5. Pneumothorax. This condition is generally conjoined with more or less hæmothorax. Air passes, either from the wounded lung or from the external wound, into the cavity of the pleura; this causes resonance on percussion over the upper part of the pleural cavity, and dulness in the most dependent part; sometimes, but not invariably, the succussion sound is present. Comparatively seldom is there any general emphysema of the tissues, unless the external wound is very small, with a great tendency to close. As a rule, if there be extravasation of air beyond the bony parietes, it escapes from the wound, and does not accumulate in the subcutaneous tissues.

(β) When the wound in the lung is produced by the fractured end of a rib, the symptoms are more limited in number. In addition to those of the fracture, there will probably be expectoration of frothy pale-red blood at first, and after two or three days rust-coloured sputum. This will be accompanied by troublesome cough, deep-seated thoracic pain, some dyspnœa, and probably a considerable elevation of temperature. There may be more or less hæmothorax, or more rarely hæmopneumothorax. Pneumothorax is not, however, so frequent after this injury as when there is an external wound. On the other hand, its place is taken by the much more frequent occurrence of a general emphysema of the cellular tissue of the parietes, and this is more frequent in the young and healthy than in the aged. Its occurrence must definitely show that not only has there been some rent in the pulmonary surface, but that the pleura costalis has also been torn through. The air must therefore pass across the cavity of the pleura before it can extravasate into the areolar tissue of the parietes. It is a remarkable fact that, under these circumstances, the cavity of the pleura but rarely fills up with air and the explanation probably is that after the lung has been lacerated, swelling of its substance very rapidly takes place, on account of its great vascularity and the hæmorrhage which consequently takes place into its parenchyma, so that the lung fully occupies the cavity in which it is contained. Consequently, the wound in the lung becomes applied to the corresponding part in the pleura costalis in which the rent has occurred, and any air which may extravasate is forced out through the wound into the general areolar tissue of the parietes at each expiration, there being no room for it in the pleural cavity.

(γ) Wound of the lung or rupture of this viscus from simple compression of the thorax, without any fracture of the ribs, is of comparatively rare occurrence. It is only likely to take place in young persons, where the ribs and sternum are very elastic. In the case of a young lad under the writer's care, there was, in addition to bloody expectoration, a limited patch of emphysema towards the root of the neck, as if air had been forced out of the rent of the lung and through the dome of the pleura in the direction of least resistance, by the violent squeeze which the chest had sustained. In this case, also, was present the peculiar capillary venous ecchymosis which often accompanies violent compression of the chest. It principally affected the parts where the skin was thinnest and the capillary blood-supply most abundant. Thus, the whole of the conjunctivæ were suffused of a pinkish tint, the whole of the skin of the face was covered with minute bluish dots, which gave it *en masse* a livid tint. The skin of the neck was also deeply affected, but less than the conjunctivæ and face. This boy ultimately recovered, the emphysema disappearing in three or four days, the capillary ecchymosis not for nearly a fortnight.

Prognosis.—This must mainly depend upon the *depth* and *size* of the wound in the lung. Small wounds are rarely dangerous; large wounds, especially those involving a large vessel, are exceedingly so.

Treatment.—The patient should be placed in bed in the most easy position; this will generally be lying over on the injured side, so as to allow the escape of blood or discharge from the wound, and to permit the freest movements of the uninjured side in respiration. No attempt at any deep examination of the wound should be made with the probe or the finger—though in cases where the hæmorrhage into the pleural cavity is considerable, a drainage-tube will be of some value. Nor is it wise to attempt the washing-out of the wound with any antiseptic lotion, when first seen. The *surface* of the wound may be washed over with some carbolic lotion (1 to 40), and then covered with protective and antiseptic gauze. The whole should then be surrounded with a bandage of moderate tightness. The tight bandaging formerly recommended is not generally borne well by patients in this state, on account of its interfering too much with the freedom of respiration. Nor is the object for which it was devised—viz. the checking of the bleeding and the prevention of extravasation of air—easily attained by this means. The bandage, then, should be of only moderate tightness, and applied more for the purpose of immobilising the wounded side of the thorax and supporting it, than for the purpose of compressing the chest. Although these wounds can rarely be rendered aseptic from the first, it is an advantage to dress them under the carbolic spray. The dressings should be changed every day or every other day in accordance with their condition. If the wound is healthily granulating, dressing on alternate days, or even less frequently, will suffice; but if there be any putridity, or much discharge, it should be made daily. If a drainage-tube has been used for very extensive pleural hæmorrhage and consequent threatened collapse of the lung, it should be withdrawn at the earliest practicable moment when equilibrium seems to have been re-established in the chest. If retained too long, it will tend to favour the entry of air and the formation of a pneumothorax.

As medicinal treatment, small doses of vinum antimoniale (♏x.), with two or three drops of tinct. opii in some liq. ammon. acetatis, are useful for checking the tendency to pneumonia, and for allaying the cough. The amount of food given during the first two or three days should be very small. The tendency to hæmorrhage may be checked by reducing the amount within the narrowest possible limits, and the writer has several times kept these patients upon only half a pint of milk for the first three or four days, with the most excellent results. A very small quantity of ice may be allowed with it to check urgent thirst. After the first four days, the amount of fluid food may be slightly increased, but it is always better in such cases to err on the side of starvation than the reverse. H. G. Howse.

LUPUS ERYTHEMATOSUS.—*Definition.*—A hyperæmia of the skin, mainly affecting the sebaceous glands and hair-follicles, and accompanied by a cell-growth. It appears in the form of one or more red, slightly raised patches, chiefly on the face, is extremely chronic, and ends, without ulceration, in atrophy and superficial scar.

Etiology.—The cause is still obscure. In certain persons, with feeble circulation and a tendency to chilblains, it seems to be provoked by comparatively slight irritating causes, such as sunburn, exposure to cold, sea air, and wind. Rich and poor are equally liable to its attacks, but females more than males. It is a rare form of lupus, and neither hereditary nor contagious.

Symptoms.—The disease may begin at any age, but usually does so between fifteen and thirty, and often lasts for life. It commences with one or more well-defined oval or round erythematous patches on the face. These gradually spread and coalesce, forming, when fully developed, what is known as the butterfly outline, the body resting on the nose and a wing extended on either cheek. Occasionally it commences on the scalp, but it is constantly symmetrical wherever located. The usual order of appearance is primarily on the nose, extending thence first to one cheek and then to the other, then to the ears, scalp, backs of hands and fingers, feet and toes, and trunk, affecting each side to an equal extent. In colour it is either of a bright red, dull brick red, or violet tint. The crust that forms on the patch, and is an important feature of the disease, varies in colour, being sometimes grey, but often yellow; and the plugs of sebaceous matter extending into the follicles render it very adherent to the skin. As the patches extend, their centres become gradually converted into thin, superficial, silvery-tinted scars. If the active process be suspended, the scarring may spread over the whole of the patches. Sometimes, even after a long period of quiescence, from some slight or scarcely apparent cause, the patches may increase in size. The edge of a well-defined patch is raised, while the centre is depressed, and, when the crust is forcibly removed, the surface is found to be red and pitted, and covered with numerous bleeding points. The mucous membrane of the lips is occasionally involved; but, speaking generally, the mucous membranes are not attacked as they are by lupus vulgaris. The whole process terminates in absorption, and there is never any ulceration. Even in cases in which large tracts of skin are affected, the general health is not usually interrupted, except in the acute and severe variety described by Kaposi, Hans Hebra, and others in Germany, in which the appearance of the eruption is accompanied by fever, often terminating in death. In ordinary cases, some smarting or burning is experienced on exposure to cold or heat, or from indigestion, but there is little or no pain.

Diagnosis.—In an early stage it is apt to be confounded with simple erythema; but, as erythema is a transitory disease, a little time will suffice to show its true nature. From eczema it can be distinguished by the absence of watery exudation, by its chronic course, and, in the later stages, by the scarring; and from acne rosacea by its raised and well-defined margin, and the absence of pustules and tubercles. Syphilis will at times imitate lupus erythematosus in such a way as to make the diagnosis far from easy, but it is of value to note that this manifestation of syphilis is usually a late one, more rapid in its course, and not so strictly symmetrical as lupus erythematosus; besides which there is the important test by anti-syphilitic drugs.

Morbid Anatomy.—At first there is dilatation of the capillary plexuses of the sebaceous glands and hair-follicles, followed by a gradual development of a small-celled growth in the surrounding connective tissue. The crusts are formed of sebaceous matter. The new growth is converted into scar-tissue by a process of fatty degeneration. According to some authorities, the sweat-glands may be primarily affected.

Treatment.—A. *Local.*—There are three distinct indications in the local treatment: (1) Soothing and astringent applications to allay smarting or burning; (2) stimulating applications to promote absorption; (3) mechanical or chemical means for the destruction of the new growth. (1) When the erythema is the chief symptom, much may be done by avoiding all sources of irritation, such as cold wind, sea air, or sun, and by the use of cooling and astringent applications, such as liq. plumbi in lotion or ointment, oleate of zinc in powder or mixed with spermaceti ointment in the proportion of ʒj. to ℥j.; calamine ʒj., oxide of zinc ʒss., glycerine fʒiss., in rose water f℥vj.; cod-liver oil, liquor carbonis deterg. fʒss. to vaseline ℥j. Complete removal of all crusts should be effected by oiling and washing with soap and water, or, better still, with soft soap and spirits of wine in equal parts. (2) Stimulating applications of various kinds may then be employed, with a view to the absorption of the new growth. Mercurial ointments, sulphur, carbolic acid, chromic acid, chrysophanic acid, pyrogallic acid, iodine, iodoform, tar, salicylic acid, chloride of zinc, in various combinations and proportions, are all recommended, and are often of service in individual cases. (3) For the destruction of the new growth there is no method so efficacious as multiple linear scarification, repeated at intervals of a week for a long period. It is successful in about half the cases, and leaves a white, soft, yielding scar. The other methods of destruction are electrolysis, galvano-cautery, scraping with a sharp spoon; or by the application of caustics, such as chloride of zinc, or Vienna paste, or the acid nitrate of mercury.

B. *Constitutional.*—Cases have been recorded, from time to time, in which benefit and even cure has resulted from the prolonged use of one of the following drugs: arsenic, iodine, iodide of potassium, iodide of starch, phosphorus, and cod-liver oil. It is difficult to give any rule for constitutional treatment further than that any deviation from health should be treated, and that one or more of the above-mentioned remedies should be tried.

MALCOLM MORRIS.

LUPUS VULGARIS.—*Definition.*—Lupus vulgaris is a chronic disease of the skin or mucous membrane, and consists of a cellular new growth in the substance of the corium, presenting the appearance of yellowish nodules of irregular size. After passing through various stages, it terminates in scars, the result of ulceration or atrophy.

Etiology.—Lupus vulgaris is less common in Great Britain and the United States than on the continent of Europe. It is said chiefly to attack people who live in cold, damp districts, and females rather than males. It is a disease of early life, making its appearance usually between the second and tenth year, but it is neither hereditary nor syphilitic. Until quite recent years, it was held by all authorities to be a manifestation of scrofula, but now that scrofula may fairly be considered to be a pathological process totally distinct from tuberculosis, the question arises whether lupus can be so classified. At the same time it is clear that certain changes in the skin resembling lupus are scrofulous in origin, but these, which should be classed under scrofuloderma, will be considered under the head of diagnosis. Whether lupus is or is not a local tuberculosis of the skin is a question of grave importance, bearing as it does directly on prognosis and treatment. Upwards of twenty years ago Mr. Hutchinson pointed out its connection with the tubercular diathesis; yet we find that out of 209 cases carefully examined by Dr. Raudnitz of Prague, although 21 cases are recorded in which there was hereditary history of tuberculosis, only 2 of them had lung-tuberculosis themselves. More recently, numerous observers have examined lupus-nodules for micro-organisms. Before Koch's discovery of the tubercle bacillus, Schüller described a microbe in the smaller tubercles of lupus, and Friedländer, Pfeiffer, Doutrelepont, Demme, Krause, Martin, Besnier, have all discovered bacilli in lupus tissue, and each has asserted the identity of lupus and tuberculosis. Schüller injected lupus into the trachea of animals, making at the same time a wound in the knee-joint, and after a certain time found tuberculosis of the lungs and the joint. Martin, using the same method, was once unsuccessful and once successful. Besnier quotes cases in which death took place from tuberculosis of internal organs in people suffering from lupus, and argues therefrom that lupus is a local tuberculosis, and may become the focus of infection of the whole body.

On the other hand, Kaposi, Vidal, and Kiener have, by different modes, subcutaneously inoculated various animals with lupus products, with only negative results. Cornil and Leloir, also, examined skin from eleven lupus patients but found bacilli in one case only. With this evidence before us, therefore, the whole question of the relation of lupus to tuberculosis must be considered as still *sub judice*.

Symptoms.—Lupus first appears in the form of a small, light-brown, or amber-coloured patch on the skin, with more or less redness round it. When pressed with the finger the redness disappears, but the patch itself, though rendered paler, retains its characteristic yellow tint. This peculiar appearance has been compared to apple jelly, and very aptly, for were a small portion of skin gouged out, the cavity filled with apple jelly, and the surface pared even with the surrounding skin, the resemblance to a primary nodule of lupus vulgaris would be complete.

When first this amber-coloured or 'apple jelly'-like nodule makes its appearance on the surface of the skin, it may be no larger than a pin's head, in which condition it may remain stationary for months or years, and then either gradually disappear, leaving in its place a small scar, or slowly enlarge. Again, there may be several of these primary nodules, which may coalesce, forming patches of irregular shape, when the rapidity of the spread of the disease will be found to be in proportion to the number of the nodules, the centre of each of which becomes gradually converted into scar tissue. The whole process is destructive, but the amount of destruction depends on the position of the nodules. When superficially placed in the corium, the resulting scar is thin and oftentimes barely visible; but, if deeply situated, the ulceration is more extensive and the scar unsightly. Though lupus vulgaris is primarily a disease of the skin or mucous membrane, it may also attack the subcutaneous tissue, muscles, cartilage, and all tissues except bone. There is, as a rule, little or no pain, and the glands in the neighbourhood of the diseased skin are usually not affected. Occasionally there is much erythema or œdema.

The different varieties of lupus depend either on the shape of the patch or on the changes it undergoes, but it cannot be too strongly stated that these are stages merely, and not separate varieties; and, as some or all of them may occur at the same time in the same individual, it would be better if the term lupus vulgaris were employed to designate all stages of the disease.

Lupus *exedens* or lupus *exulcerans* are terms applied to the disease when there is distinct ulceration, a phase usually confined to the nose or cheeks; lupus *non-exedens* when there is no ulceration. When the nodules shrivel and disappear with more or less desquamation, but without ulceration, the variety is termed lupus *exfoliativus* or *exfoliaceus*; while the huddling together of the nodules, so that they project considerably above the level of the skin, is called lupus *hypertrophicus* or *tuberculatus*. Should a patch of irregular outline be formed by the fusion of two or more patches, lupus *serpiginosus* is produced; but if it present the appearance of numerous scattered isolated points it is called lupus *disseminatus*. McCall Anderson adds yet another variety which, because of certain warty growths appearing on the tubercles, he calls lupus *verrucosus*, but which Vidal designated lupus *scléreux*.

Lupus usually shows itself first on the skin of the nose, and the parts subject to attack next in frequency are the cheeks, and then the extremities. Next in order are the ears, mouth, gums, pharynx and larynx, eye, and female genital organs. The scalp is seldom attacked primarily. The disease on each part will now be briefly noticed, and its differential diagnosis, distinguishing it from certain other diseases, given.

Lupus of the Nose.—At first, in most cases, one or more small yellowish-red spots appear on the skin near the tip or at the sides of the nose. When these early nodules occur in the first decade of life, they are easily distinguishable from simple inflammatory diseases; from eczema by the absence of moisture and persistence, and from psoriasis by the immunity of other parts of the body and by the absence of the silvery scales. Their resemblance to true scrofulous nodules renders the diagnosis in an early stage less easy. The scrofulous nodules are harder when pricked, paler, and more raised than lupus. They are usually more rapid in growth and tend to ulcerate more quickly, and, as a rule, the neighbouring lymphatics are involved. When the first appearance occurs during the second decade, at or soon after the age of puberty, the lupus nodules are apt to be mistaken for either acne vulgaris or a secondary manifestation of syphilis. The lupus nodules are, however, usually larger than acne, not limited to sebaceous glands, not pustular, soft when pricked, and are of longer standing. They are distinguished from syphilitic nodules by the absence of the cachexia, enlarged glands, sore-throat, and the mixed eruption usual in that disease. Lupus of the nose is sometimes difficult to diagnose from acne rosacea. The age at which the disease showed itself, the presence of apple-jelly nodules and scarring, are the guides.

Lupus of the Cheeks.—Lupus vulgaris is a non-symmetrical disease; it is, therefore, not uncommon to see on one cheek a single patch that has lasted for years, or both cheeks may be attacked by extension from one side, or as a result of several nodules scattered on the nose and cheeks. It is interesting to notice that, however much the disease may extend, the forehead and chin, as a rule, escape attack. Diagnosis of a single patch of lupus is not always easy, but it will be discernible from eczema, psoriasis, and acne rosacea for reasons already mentioned. Lupus may be distinguished from scrofuloderma by its hardness, and the frequency with which it appears in scars after abscesses. Enlargement of the glands and other signs of scrofula, such as catarrh, serve to distinguish scrofula from true lupus. Tertiary tubercular syphilide may be recognised by the age at which the disease first appeared, by the rate of its growth, by the shape and colour of the patch, and by the history and presence of old scars. When attacking both cheeks and nose and not ulcerating, lupus vulgaris may be confounded with lupus erythematosus, which may be distinguished from it by its symmetrical distribution, by the age at which it appears—usually after puberty—by its superficial character and its total freedom from ulceration, by the absence of apple-jelly tubercles, by the colour and nature of the crusts, and the plugs on the under surface when removed.

There is a variety of lupus vulgaris, occasionally seen on the face, which often ulcerates, leaving small pits, and which, from its resemblance to common acne, has been called *acne-lupus*. The chief features of chronic ulcerating lupus of the face, which may be mistaken for simple scrofulous ulceration, epithelioma, rodent ulcer, and tertiary syphilis, are the age of the patient, the mode of origin, the rate of growth, the character of the ulcer, and the constitutional effects. Both lupus and scrofula commence in early life, the latter in a hard tubercular nodule which breaks down speedily, forming an ulcer with a thin undermined edge; the surface is either devoid of granulations or covered with pale flabby granulations which bleed easily, and the surrounding skin purple or red. The lymphatic glands are enlarged, and there are usually other signs of scrofula. There are nodules of lupus around the lupus ulcer, the edges of which are not well defined. The discharge is yellowish but not offensive, forming thick scabs, and there is a tendency to heal in the centre. Epithelioma and rodent ulcer usually commence in middle or late life, and generally at the junction of skin and mucous membrane, as, for instance, the margin of nostril or eyelid; and usually from one point, and not several, as in lupus, and the process is very slow, as a rule lasting for years. They differ from lupus in their tendency to destroy deep tissues, including bone, and by showing no disposition to heal. The rodent ulcer is cavernous, the base smooth, and the edge firm and inelastic. The syphilitic ulcer spreads serpiginously, often with an outline of a horse-shoe shape, unlike lupus; in addition to which the edges are sharply defined, the discharge is foul, and there is a tendency to destroy deep tissues, including bone. Its rate of growth is usually more rapid than that of rodent ulcer or epithelioma, and the existence of early symptoms of syphilis and the presence of scars are important data.

Lupus of the face, by destruction of the skin and scar-contraction, may produce the most terrible deformity. Ectropion and dragging of the mouth and nose are common results, as also loss of a great portion of the nose.

Lupus of the Ear.—The ear may be attacked either primarily or by extension from the face. The disease may commence on the membrana tympani and spread outwards, or on the outer ear and ultimately involve the membrane, from which cause deafness frequently results. The destruction and deformity are also at times very great, leaving the external meatus permanently contracted.

Lupus of the Trunk and Extremities.—Lupus may attack any part of the surface, and differs in appearance according to the part attacked. It may start and pursue its course in the same way as on the face, though as a rule the process is even slower. There is a variety, most severe in character, which has been described under the name of *lupus mutilans*, which attacks the fingers and toes, ulcerating greatly, and causing much destruction, contraction, and deformity.

Lupus of the Mucous Membranes.—This may either commence in the mucous membrane or may spread thereto from affected skin. When primarily affecting the mucous membrane it is difficult to recognise, and there is little doubt that it has often existed long prior to its discovery. The nasal mucous membrane is that most commonly attacked, next the mouth and pharynx, and occasionally the larynx, while the rarest parts are the genital organs, both male and female.

In the nose, the first indication is a scab or crust and a slight sensation of soreness. If the scab be removed the exposed surface bleeds easily, is sensitive to the touch, and soft when scraped. If not arrested at this stage deep ulceration may ensue, often causing the complete destruction of the cartilaginous septum. In the mouth, isolated patches may occur on the lips, which become swollen and everted, on the gums and on the hard and soft palate. The tongue is rarely affected. The conjunctiva is seldom attacked primarily, but occasionally by extension from the cheeks.

Morbid Anatomy.—Sections of skin affected with lupus vulgaris show under the microscope small scattered nodules, arranged like nests in the fibrous connective tissue, composed of young cells situated in a highly vascular network. The surrounding corium is at first free, but gradually the small-celled growth extends along the vessels, or the sweat-glands, or the hair-follicles and sebaceous glands, until the whole depth of the corium is involved. The epidermis, at first unaffected, becomes hypertrophied. Fatty degeneration and absorption may take place in the deeper nodules without destruction of the epidermis, or ulceration of the whole substance of skin and subcutaneous tissues may result, followed by cicatrisation.

Treatment.—A. *Local.*—Whatever method is used, the ultimate aim in the treatment of lupus is the total destruction of all the existing lupus tissue. This is not an easy matter, even when the parts are well within the surgeon's reach. Each method has its advantages and disadvantages, and care must be taken to select that most suitable to the individual case. When there is much erythema or œdema in the neighbourhood of the patch, soothing or astringent applications, such as lead or zinc, are for the time preferable to violent caustic or surgical treatment.

The points of most importance, in selecting a method to destroy the growth, are the thoroughness of the destruction and the kind of scar produced by the process.

The various means may be divided thus:—1. Mechanical. 2. Chemical.

1. *Mechanical.*—When the disease is situated on the face and is superficial, much improvement, and often cure, can be effected by free scarification. By this process only diseased tissue is destroyed. If the parts be more deeply involved, scraping, with one of the many kinds of curette or spoon, is often attended with the most satisfactory results. In all forms of ulcerating lupus, and in lupus of the mucous membranes, scraping is to be preferred to any other treatment. The scraping, to be effective, must be done thoroughly and repeated constantly, so as to destroy every vestige of the new growth. In disseminated lupus, a narrow curved spoon may be introduced into a nodule and pushed subcutaneously into a neighbouring one, when both nodules can be broken up by rotating the spoon. The writer has introduced a double screw for the complete destruction of small isolated nodules.

The actual cautery is strongly advocated by some, and at times excellent results are obtained by its use. For this purpose Paquelin's thermo-cautère is the best way of applying it. A fine point, heated to redness, should be firmly inserted into each nodule until the resistance of the sound tissue is felt. Care must be taken not to operate on too large an area at one time.

The ultimate scar is not so satisfactory as that attendant on scraping, as much thick cicatricial tissue often results; but it is a suitable method of treatment for isolated nodules which have resisted other treatment. The galvanic cautery is strongly recommended by Dr. Besnier of Paris, because it destroys without blood-letting. Occasionally, it is useful to combine scraping and cautery, first scraping out as much of the diseased tissue as possible, and then lightly cauterising the raw surface. Weak solutions of perchloride of mercury, chloride of zinc, carbolic acid or boracic acid, or finely-powdered iodoform, are suitable dressings after either scraping or cautery.

2. *Chemical.*—The local treatment of lupus by chemical means alone must be looked upon as a somewhat obsolete method. Many have been recommended, but none are really satisfactory. In superficial cases, no doubt, some caustics are useful, but in consequence of the difficulty in regulating their action, they either destroy too much or too little. If strong acids are employed, such as nitric, more tissue may be destroyed than is necessary; or if weaker caustics are used, such as nitrate of silver, a solution of potassa fusa, carbolic acid, or arsenic paste, the diseased tissue may be only partly destroyed, and the remainder stimulated to renewed action. Injections into the nodules, by means of a small syringe, of a caustic solution, such as iodine 1 part, glycerine 20 parts, have been successful in the hands of Schiff of Vienna and others.

B. *Constitutional.*—It is difficult to lay down any rigid rules for guidance. It is doubtful whether there is a drug that has any specific power in preventing the formation or development of true lupus vulgaris. Lupus usually occurs in healthy people, but if there be any deviation from health it should, of course, receive attention.

Some authorities strongly advise the administration of such drugs as iodine, iodide of potassium, phosphorus, arsenic, iron, cod-liver oil; and, as no harm can accrue, it is wise to give the patient the benefit of a trial of one or more of them, at the same time impressing the opinion that without active local treatment the chance of cure is remote, if not impossible.

MALCOLM MORRIS.

LYMPHADENITIS or ADENITIS.

These terms are applied to inflammations of a lymphatic gland. There are many varieties of the process, and the cases may be divided into such as are acute, subacute, or chronic. The more useful and more usual division of adenitis, however, is based upon the nature of the morbid process involved, and is a division of the forms of the malady according to their kind rather than their degree. By this arrangement three principal varieties are separated: 1. The simple, 2. The scrofulous or tubercular, 3. The syphilitic. Besides these there are other specific forms, among which may be mentioned the adenitis met with in farcy, in the plague, in erysipelas, pyæmia, &c. The present article is concerned only with simple adenitis. The other forms will be found described under BUBO; GLANDERS; SCROFULA; SYPHILIS, &c.

SIMPLE ADENITIS, BUBO.—*Pathology.*—The inflammatory process when it involves a gland differs in no way from a like process attacking other parts of the body. It may assume an acute, subacute, or chronic character. In acute cases the gland is swollen, and is softer and moister than usual; on section it is red and often presents hæmorrhagic patches. The change is first observed and remains most marked in the cortex of the gland; all the blood-vessels are dilated, and the lymph-channels are blocked with leucocytes, among which will be found a few red blood-corpuscles. In the follicles also the number of lymphoid corpuscles is greatly increased; as the cells accumulate at any one part, that part becomes paler and the hyperæmia diminishes. The fibres of the reticulum become swollen and soften, and after a while break down, and the anatomical details of a large portion of the gland are lost. In the least severe cases resolution follows. The leucocytes undergo fatty degeneration and are absorbed, the congestion diminishes, and the gland becomes flaccid. In other cases—taking them in order of severity—suppuration takes place, either in isolated spots or throughout the substance of the disordered gland. This pus will probably be discharged, but, in cases that become chronic, its fluid parts may be absorbed and it may form a caseous mass in the centre of a disorganised and inactive gland. If the tension within the capsule has been considerable during the acute stage, the blood-vessels may become so compressed that the gland-tissue perishes, in whole or part, by necrosis. When the capsule is divided, it is found to be occupied by a sloughy mass. In another series of cases the inflammation becomes chronic. The congestion diminishes, and the gland becomes the seat of an extensive growth of new connective tissue. This tissue is of low organisation and ill-formed. It may develop into fibrous tissue and the gland be converted into an indurated mass composed mainly of this structure (cirrhosis, or fibroid induration), or the newly formed material may break down here and there, and small collections of pus be formed, which will probably find their way to the surface from time to time.

Thus, an acutely inflamed gland may undergo resolution, or may suppurate or perish by necrosis, or may pass into the condition of chronic inflammation or long-abiding suppuration. It may become converted into a more or less permanent fibroid mass. It may caseate and in time become calcareous. It may undergo resolution, and after that may atrophy more or less completely. After having been once inflamed, it may at future times become again and again inflamed upon slight provocation, or, after having been quiescent for months or years, suppuration may be excited in it with singular ease. Such suppuration will take place about the residues of the primary inflammation, and will constitute the form of abscess termed by Paget 'residual.'

Causes.—Adenitis is nearly always secondary, and due to the absorption of morbid material from a focus of inflammation at the periphery. The lymphatics conveying that material to the gland may or may not be inflamed themselves. Adenitis may follow upon wounds, especially upon such as are septic or are irritated by the presence of a foreign substance. It occurs especially, also, in cases where pus has not a free vent, as in small sores covered with a scab. It is often seen after wounds exposed to continued irritation, as after abrasion of the heel from friction of a shoe. It would appear that, in rare cases, glands have been inflamed by the absorption of animal poisons through the skin, the integument presenting no breach of surface. Glands may be inflamed by direct violence; as an example of this, may be cited the case of a healthy man whose cervical glands became acutely inflamed after an accident in which the neck had been severely compressed. It is possible also that adenitis may sometimes be excited directly by exposure to cold. Inflammation in the vicinity of a gland may spread to that body by direct continuity of tissue, without of necessity reaching it by means of the lymphatics. Some individuals are more liable to adenitis than others. It is more common in the young; it is comparatively rare in the aged. It is often met with in those who are debilitated, as, for example, in children convalescent from fevers. The inflammation in the glands will partake of the character of the primary inflammation. It is indeed, a mere reproduction of it. The mischief in nearly every instance stops at the first chain of glands above the seat of the primary mischief. In some rare cases the inflammatory irritant is passed on, but always in a much modified and milder form, to the chain of glands next above those the seat of the adenitis.

Symptoms.—The gland becomes swollen, painful, and tender. It is at first movable, but soon becomes fixed. This latter symptom depends partly upon the increased size of the gland, partly upon inflammation which is usually excited in the connective tissue around the gland (peri-adenitis). The pain is lancinating and, as suppuration appears, throbbing. It is made worse by movement, and is somewhat relieved by relaxation of the part. As the disease advances, the skin becomes stretched, red, glazed, and frequently œdematous. Fluctuation appears in the centre of the indurated mass, and suppuration is evident. In time the pus finds an escape upon the surface. One gland alone may be affected, but, as a rule, others in the series become enlarged, not simultaneously but consecutively. In any case, one gland is usually more extensively involved than any other. Much of the pus is probably derived from the connective tissue around the gland. If this tissue be lax, the abscess may attain considerable size and the skin become in consequence greatly undermined. If many glands are involved, there may be lymph-œdema in the parts from whence their afferent vessels are derived.

The process, especially when suppuration occurs, is attended by a varying amount of constitutional disturbance. There may be a rigor, there is pyrexia with its accompanying symptoms, and sometimes much prostration. Adenitis of deeply seated glands, as a rule, causes more severe disturbance and more pain than adenitis of a superficial gland. This depends upon the confined position of the deeper gland and the tension that the inflammatory swelling produces. The writer has seen most severe symptoms attend adenitis of the small gland that lies in contact with the septum crurale. When the gland is surrounded by lax connective tissue, an extensive abscess may form without producing any marked constitutional disturbance. The possible modes of ending of a case of adenitis have been already indicated in speaking of the pathology.

In the *diagnosis* of the acute affection there can be little difficulty. The position of the swelling in the site of well-known glands; the probable evidence of an exciting cause and of a connecting lymphangitis; the circumscribed nature of the swelling and the probable enlargement of other glands in its vicinity, all tend to point to a precise diagnosis. The indolent and chronic enlargements are not always so easy to recognise. In the inguinal region, for example, they have been mistaken for irreducible femoral epiploceles and for solid growths of various kinds. In the diagnosis the position of the swelling should be noted, its circumscribed character, the fact that it can be more or less isolated, the probable presence of slighter gland enlargements in the vicinity, the tenderness of the swelling, the history of an exciting cause and, possibly, of a subacute initial attack.

Treatment.—In the first place, the primary cause of the trouble (wound, abrasion, ulcer, abscess, &c.) should be sought for and so treated as to encourage its healthy healing. With regard to the adenitis, rest of the part must be at once secured, and the limb put in such a position as to relax all the fascial tissues about the seat of the disease. Thus, when the groin is involved the patient should seek the recumbent position, and keep the thigh a little flexed by placing a pillow beneath the knee. To the gland itself an ice-bag should be applied. If applied early, it gives relief and appears to prevent suppuration. A degree of cold less than that of the temperature of ice appears to do harm rather than good, and to increase the pain. In some cases, when ice cannot be borne, the local application of extract of belladonna with equal parts of glycerine will give immediate relief, with or without a fomentation or poultice. Warm applications relieve, probably by relaxing the parts and by lessening tension, but they certainly appear to encourage suppuration. When the presence of pus is evident, it should be evacuated at once. The incision should be free, in the long axis of the tumour, and almost as extensive as the abscess-cavity. On no account should the pus be squeezed out of the cut; it should be allowed to escape of itself. Squeezing the part merely damages the fine lining membrane of the abscess, where such exists, and breaks up the softened and inflamed gland-tissue. Immediately after the incision a poultice should be applied. In twenty-four hours, if all the pus has escaped, the cavity may be syringed out with a 1 in 20 solution of carbolic acid, and, after a few more days of poulticing, it may then be dressed from the bottom. The little sac should be gently filled with lint soaked in glycerine and carbolic acid (1 in 20), or with gauze well powdered with iodoform.

The method of treatment by a small incision and a drainage-tube often leads to very tardy healing. Sometimes the pus is mainly in the connective tissue about the gland, and when the abscess is opened the inflamed lymphatic body may be seen exposed at the bottom of it. Such a gland should be removed. It can be taken away by a few touches with the thermo-cautery. If left, it is apt to lead to serious trouble and to greatly retard the closing of the cavity. When the healing is sluggish the part may be dressed with carbolic acid and glycerine in the proportion of 1 in 10, or with a solution of nitrate of silver (15 grs. to the ounce), or touched daily with a solid piece of sulphate of copper. When the skin is much undermined about a sinus, the integument should be divided so far as the undermining extends, and the cavity thus exposed dressed from the bottom. If the purple skin at the edge of such a sinus be greatly thinned, it may be destroyed with the thermo-cautery. When extensive chronic sinuses result from adenitis, they require active treatment. When possible they should be slit up, the unhealthy granulations which line them should be scraped away with a Volkmann's spoon, and the resulting cavity dressed from the bottom with some stimulating application. Sinuses that are too deep to be slit up should be scraped, and then dilated fully by the use of a sea-tangle tent. When this has been done they may then be dressed from the bottom. Sometimes the sinus depends upon the presence, at the bottom of the wound, of a fragment of a degenerating gland. The softened tissue of such a gland should be scraped away with a Volkmann's spoon, or be destroyed with the cautery. After both proceedings a drainage-tube should be used for a while. *See* Sinuses.

In dealing with chronic and obstinate sinuses, it is most important that the part be kept at rest. This precaution is usually neglected in the case of cervical sinuses, and the chronicity of these depends, the writer thinks, largely upon the constant movements of the neck. In such cases the parts should be fixed by a simple stock of guttapercha, fashioned to the neck and taking its fixed points at the lower jaw and the upper part of the chest. The writer has used such stocks extensively, and has found them well borne by the patient and of extraordinary value in many obstinate cases.

In very chronic, indolent gland-enlargements without breach in the integument, much can be done by attending to the general health, by change of air, by sea-bathing, and by the use of tonics, especially of iron. The simplest local treatment consists in the rubbing into the part, night and morning, of a little of the Ung. plumbi iodidi. This should be rubbed in for five minutes, and until the skin is a little red. This treatment is more certain and more efficacious than the painting of the part with iodine, which may, however, be tried if the ointment fails. In certain cases the gland resists all such treatment; it remains enlarged, is painless and perfectly quiescent. Such swellings may, for a while at least, be left alone. If, for any reason, their removal seems needed and they are solitary and well isolated, they may be excised, although the cases where excision is suitable are very few. If the indolent gland remains tender, and is still enlarging very slowly and is fixed in the tissues, it probably contains some suppurating foci in its interior. It is then best treated by thrusting the finest point of the thermo-cautery through the skin into the gland, and by passing the point in several directions through the gland without enlarging the skin-puncture. A drainage-tube should be finally introduced, and the part poulticed. By this means a gland which has long given trouble can often be got rid of, without leaving any but the slightest scar.

Frederick Treves.

LYMPHADENOMA.—The primary non-inflammatory tumours of lymphatic glands have been subjected to many classifications, are still surrounded by an atmosphere of pathological doubt, and are burdened with a confused nomenclature. Under the term lymphadenoma may be comprised four kinds of new growth, viz.: 1. Simple Lymphoma; 2. Non-Leukæmic Lymphadenoma; 3. Leukæmic Lymphadenoma; 4. True Sarcoma. To each of these different tumours the term lymphadenoma has been applied by one author or another.

The above division includes all the primary non-inflammatory growths to which the lymph-glands are liable.

1. Simple Lymphoma.—In this affection a gland enlarges without visible cause. By slow and gradual degrees it forms a tumour, that may be the size of a hen's egg or even larger. It is accompanied by no inflammatory symptoms, by no pain, by no tenderness. It contracts no adhesions. It is smooth and rounded, firm but elastic. It is usually found in the neck. As a rule only one gland is involved, but one or even two other glands in the vicinity may be affected. It does not affect the patient's health. It is a purely local affection, and does not recur after removal. It is associated with no constitutional defect. It shows, on section, a simple homogeneous aspect, and is composed of a new growth having precisely the structure of the follicles of a normal gland. It is difficult to decide whether the tumour is a neoplasm or a mere hypertrophy. In any case it is an innocent growth.

2. Non-Leukæmic Lymphadenoma.—This disease is also known as Hodgkin's disease, adenia, pseudo-leukæmia, malignant lymphoma, and by the misleading term 'lympho-sarcoma.' In this form certain glands become enlarged without apparent cause, they increase in size, the disease spreads from gland to gland until a whole chain is involved. The tumours formed appear as large, round, smooth masses made up of clusters of enlarged glands. The disease usually begins in the neck, sometimes in the inguinal or axillary glands, and rarely in those in the interior of the body. In time, nearly all the more conspicuous glands in the body may be affected.

Etiology.—The causes of this disease are quite unknown. It is unconnected with scrofula, syphilis, or inflammation, It is somewhat more common in the delicate. It is three times more common in males than in females. Most of the cases occur between the ages of 25 and 35, and next in frequency between the ages of 5 and 12; it is rare after 45.

Symptoms.—The tumours increase without inflammatory symptoms, are not tender, and are not painful unless they grow quickly. They form smooth, prominent, bossy tumours which do not contract adhesions and which remain well encapsuled. Pyrexia is rare. The patients become debilitated and anæmic; they emaciate and lose their appetite. Profuse diarrhœa and dropsy are not infrequently observed, and the sufferer dies usually of exhaustion. Pressure symptoms may be produced. Gland-tumours in the neck may cause laryngeal troubles and dysphagia, sympathetic paralysis, and congestion of the great cervical veins. Tumours in the thorax may press on the trachea or lung or gullet, or may interfere with the action of the heart. Those in the abdomen may press upon the portal vein or bile-duct, and produce dropsy or jaundice. Masses in the groins or armpits may cause œdema of the corresponding limbs. Secondary deposits may develop in the alimentary canal, the liver, the kidneys, the medulla of the bones. The spleen is usually conspicuously affected, but it is important to note that there is no leukæmia. Death follows, on an average, in twelve months. The disease may end fatally in six months, or the patient may survive two or even three years.

The gland tumours are distinguished from those of scrofula by their wider distribution, their enlargement without visible cause, and the absence of inflammation. They form larger masses than are met with in struma, they do not suppurate nor become adherent to the skin, and they are usually not tender. They are not benefited by a treatment which would probably greatly influence scrofulous swellings.

Pathology.—The tumours are of two kinds, the soft and the hard. The former are quite soft and juicy, and homogeneous on section. The latter are firm, are also homogeneous, and yield but little juice. Transition forms between the two varieties are found. Microscopically, both kinds of tumour are composed of a tissue precisely resembling that of a normal lymph-follicle. The mass, indeed, is so like a gland that is composed wholly of follicles. The secondary deposits have the same character. The hard lymphadenoma differs from the soft in one particular only, its cell-elements are not so numerous, while the development of the reticulum and fibrous parts of the gland is peculiarly conspicuous. Clinically, the two forms are precisely alike and adopt the same course. The only differences consist in the different physical characters of the two forms of tumour, and in the fact that the hard lymphadenoma forms somewhat smaller masses.

3. LEUKÆMIC LYMPHADENOMA. — This disease resembles in nearly all respects, both clinically and pathologically, the affection just described as soft non-leukæmic lymphadenoma. Microscopically the tumours have precisely the same structure, and the appearance of the growths and the characters of the secondary deposits are practically the same in the two affections. Indeed, it may be said that there are only two main points of difference between these closely allied disorders. In the present disease the spleen is more conspicuously affected, and is implicated at an earlier period, while the blood presents the evidences of leukæmia.

It will be seen that, microscopically, these three forms of lymphatic gland-tumour are almost identical. The differences which some pathologists have maintained to exist between them are ill-marked and questionable. Indeed, it would be very difficult to differentiate these three forms by the microscope alone, provided that the examination were limited to the tumours. All these growths would appear to represent grades or degrees of one common affection. Why in one case the disease should remain an innocent local affection, while in another it assumes malignant characters, and in a third produces leukæmia, must remain at present a pathological mystery.

4. TRUE SARCOMA.—In rare instances sarcoma has appeared in a lymphatic gland as a primary tumour. Examples of round-celled, of spindle-celled, and of alveolar sarcoma have been met with in this situation. The growth commences in the connective-tissue reticulum or in the tissue around the vessels. The tumours differ in no way from sarcomatous growths appearing elsewhere. They may be distinguished from the other lymphadenomata by the following features:—Only one tumour is formed; it remains limited, for a long time at least, to one set of glands; it tends to invade the adjacent parts and to protrude through the skin. There is no leukæmia, nor the debility which is an early symptom in lymphadenoma.

Treatment.—1. In the treatment of simple lymphoma no measure is of any avail short of extirpation of the tumour with the knife. Medical treatment will neither retard the growth of the neoplasm, nor diminish its proportions when it is fully formed. Excision is easily performed, and the tumour has no tendency to recur.

2. In Hodgkin's disease surgical treatment is of little or no avail. Excision, to be of any service, must be performed at the very commencement of the malady, and, unfortunately, when the tumours first appear their precise nature is difficult to diagnose. By the time that the nature of the malady is beyond doubt, the case is probably beyond any surgical treatment. The benefit that has been obtained from a free extirpation of the growths has been temporary only, and has been purchased at a great immediate risk to life. When one definite tumour is causing troublesome symptoms from pressure, its removal may give the patient much relief. When the neck is involved and there is some risk of laryngeal stenosis from pressure, it is well to perform tracheotomy before the growth is so extensive as to hide the trachea. Local treatment of the growths by iodine, counter-irritants, setons, caustics, injections into the substance of the mass, electrolysis and subcutaneous crushing of the gland, is useless

when not actually harmful. The patient should be placed under the most favourable hygienic conditions. Cod-liver oil should be administered, and in every case iron. This may be given in the form of the sulphate or the perchloride, and, when these forms are not well borne, trial may be made of the hypophosphite or of Parrish's chemical food, or of Easton's syrup or Bravais' iron. Much good often attends the use of the syrup of the iodide of iron. The iron should be given with quinine or with nux vomica. In some cases, especially when the patient's health is still fairly good, benefit has followed the administration of iodide of potassium in increasing doses (from 5 grains three times a day to 20 or 30 grains). Many physicians strongly recommend arsenic. It should be given in increasing doses, until at last 20 or 30 minims of Fowler's solution are taken every day.

3. In leukæmic lymphadenoma any surgical interference is distinctly counter-indicated. The treatment of the case is the treatment of a case of leukæmia.

4. The treatment of sarcoma of lymphatic glands differs in no way from the treatment of that growth when attacking other superficial parts. *See* Sarcoma.

Frederick Treves.

LYMPHANGIECTASIS and LYMPHANGIOMA.

—The lymphatic vessels are liable to the same species of dilatation and the same kind of varix that are met with in the blood-vessels. They may present conditions that have their counterpart in nævus, in varicose veins, and in arterial varix or cirsoid aneurism. To the lesser degrees the term 'lymphangiectasis' is applied, to the more pronounced the term 'lymphangioma.' In the milder forms—as seen in the surface lymphatics—the vessels are dilated and tortuous. The dilatation is usually unequal. Ampullæ are apt to form, especially in the vicinity of the valves, and to appear under the thinned integument as minute vesicles. The dilated vessels themselves, moreover, can be both seen and felt beneath the skin, which is apt to become atrophied over them.

When the smallest vessels are most involved, distinct networks of varicose lymphatics may be formed (Reticular L.), but when the larger trunks are attacked, a series of long tortuous tubes only is to be seen (Tubular L.). In some cases of tubular lymphangiectasis the varicosity may be considerable, and, in one reported instance, the inguinal lymphatics were so dilated as to be mistaken for a hernial protrusion.

In certain instances the lymphangiectasis is congenital. In others it has followed upon occlusion of some lymphatics after lymphangitis. In another series of cases one may assume that the dilatation has been produced by conditions resembling those that cause varicose veins. The condition is more common in tropical countries than in Europe or in colder climates. The parts most often attacked are the lower limb, the scrotum, and the lower half of the abdomen.

Lymphangiectasis is often associated with solid œdema of the parts concerned, and with some local malnutrition. The little vesicular ampullæ are apt to rupture, and to lead to a troublesome lymphorrhœa. These dilated vessels, moreover, are frequently the seat of lymphangitis.

The *treatment* of lymphangiectasis is purely palliative, The parts should be protected from pressure and injury, should be kept raised when possible, and should be supported by slight elastic pressure.

In lymphangioma vessels of good size are involved. They are extremely dilated, and form large ampullæ, and cavities of the most varied shapes. Adjacent cavities are apt to break into one another, until a mass of intercommunicating cavernous spaces and passages are formed, all lined with endothelium. The condition is identical with that known in the blood vascular system as cavernous angioma, and is therefore usually termed lymphangioma cavernosum. This condition is probably always congenital. It underlies many hypertrophic conditions, such as macroglossia, macrochelia, and certain forms of elephantiasis, and is said by some to be the actual cause of congenital hydrocele of the neck. It is, moreover, very generally acknowledged to be the anatomical basis of certain forms of 'giant growth' in the lower limb. In some instances the lymphangioma has assumed the form of an isolated cystic tumour, and has, when in this condition, been incised, under the impression that it was a chronic abscess.

Such isolated tumours have been excised with success. Omitting these exceptional tumours, the treatment of lymphangioma cannot be considered apart from the conditions of tissue to which it leads, such as macroglossia, giant-growth, and the like.

A lymphangioma may involve the channels of a lymph-gland, and a large cystic tumour be in consequence produced. To such growths the term lymphadenectasis has been applied. Frederick Treves.

LYMPHANGITIS, or ANGIOLEUCITIS.—These terms are applied to an inflammation of the lymphatic vessels. The inflammatory process is not necessarily limited to the lymphatics. Indeed, in nearly every instance of lymphangitis there is a visible implication of the corresponding glands. In the milder forms this implication may, however, be so slight that its effects may not be perceptible. The terms are conveniently applied to cases where the inflammation of the lymph-vessels is conspicuous, and is—for a time at least—predominant.

Causes.—Lymphangitis is in almost every instance secondary. Some irritative process is excited among certain lymph-radicles; an inflammation follows, which runs along the lymphatic vessels. The primary lesion is usually inflammatory, and depends upon a wound, stab, prick, or abrasion, or upon some ulceration or purulent collection. Lymphangitis has, however, followed upon simple sprain, and even upon long-continued or rough friction of the skin. Cases of sunburn—especially when involving the forearm—are often associated with quite an extensive lymphangitis of slight degree. The larger lymphatic vessels may be involved by the direct spreading to their walls of some inflammatory process in their vicinity. Some individuals are much more liable to lymphangitis than others, and especially those who are in feeble health, or who are the subjects of Bright's disease, or who have been debilitated by alcoholism. The disease is more common during youth and adult life than during childhood and in old age. The local exciting cause may be very trivial—a slight scratch, a minute puncture, the sting of an insect. In many cases it has probably been overlooked, and the lymphatic trouble regarded as primary. Lymphangitis is especially apt to occur when the body has been inoculated with decomposing animal matter (*see* Poisoned Wounds). It is often met with, therefore, in medical men, in those engaged in dissecting, in butchers, cooks, &c. In suppurative affections, it is most commonly met with in cases where pus is closely retained. It is more likely to attend a minute abscess of the finger, where a bead of pus is retained, than the large suppurating surface of an amputation flap. There are certain forms of lymphangitis due to specific poisons, as illustrated by those attending erysipelas, malignant pustule, glanders, pyæmia, &c.

Pathology.—The inflammation most conspicuously involves the outer coat of the vessel, and the mischief is peculiarly apt to spread to the adjacent connective tissue. The intima becomes opaque, and its epithelium degenerates.

The contents of the inflamed vessel are no longer clear. They often appear fatty, or even puriform. Sometimes the contained lymph coagulates, and the vessel becomes plugged. In slight cases complete resolution follows, the vessels remaining a little dilated for a while. In a severer grade of the disease, the walls of the lymphatics remain greatly thickened, the adjacent connective tissue is sclerosed, and the lumen of the tubes is narrowed or obliterated. The coagula—when they exist—may become organised, or may break down into a pus-like matter. In the severest cases of lymphangitis, the walls of the lymph-vessels and the connective tissue outside those walls suppurate, pus fills the interior of the lymphatics, and the involved parts may slough, or at least undergo extensive destruction. Suppurative lymphangitis is often the starting-point for a severe and wide-spread inflammation of the cellular tissue. *See* Cellulitis.

Symptoms.—To take a typical case. Let it be supposed that a man has an abrasion upon his knuckle, which becomes infected with some putrid matter. For one or two days nothing takes place, then about the wound an extensive red areola appears. This is due to implication of the primary lymphatic network (reticular lymphangitis). From this areola lines are soon to be seen running up the forearm to the gland above the inner condyle, and towards those in the axilla. These lines are of a faint pink, are sometimes straight, sometimes wavy, and always very narrow (tubular lymphangitis). They soon become painful on pressure, palpable to the touch, and usually in time form perceptible cords, while the redness over them becomes more diffused and less distinct. One or more glands will now be distinctly enlarged and tender, and, with the development of the glandular inflammation, the inflamed lymphatics will become less conspicuous. The affected parts of the limb are hot, and the seat of a burning or throbbing pain. If many lymph-vessels are involved, œdema will appear as a result of the blocking of the lymphatic channels. The disease may be ushered in with a rigor. There is a good deal of pyrexia, a feeling of malaise, and a certain amount of prostration. At the end of a few days or a week the inflammation subsides, and the parts are restored to their normal condition. As a rule, the œdema, when it exists, is slow to disappear, and usually the adenitis persists for a while, and often runs on to suppuration. In other cases the areola around the wound may be very slight: there may be little reticular lymphangitis. There may be tracks of tissue free from all evidences of disease between the wound and the inflamed lymph-canals, or between this tubular lymphangitis and the enlarged glands. The trouble may pass on to suppuration. This may spread, and involve extensive tracts of the subcutaneous cellular tissue. More frequently the suppuration occurs in the glands, and in either case the condition may lead to septicæmia or pyæmia.

When the deep lymphatics of a part are involved, the redness may be absent or present only in patches. The pain will be very severe, and the part very tender. There will be much swelling, which will be more or less diffused. When suppuration occurs in these cases, a very grave cellulitis may ensue. In any case the lymph-vessels may become occluded, some lymph-œdema may persist, and the part become brawny and hypertrophied.

The prognosis in lymphangitis is good. The only risk to life depends upon the suppuration, and death may ensue from any of the fatal issues that may attend suppuration. Other things being equal, it may be said that the nearer the lymph-disturbance is to the periphery, the less grave is the morbid condition,

Treatment.—The primary cause of the lymphangitis should be sought for and carefully treated. Any collections of pus at the primary focus should be freely opened, and, after having been well washed with a solution of carbolic acid or corrosive sublimate, the part should be treated with a charcoal poultice. The freest vent must always be given to the pus. Unhealthy wounds should be cleansed in the same way, and then dressed with iodoform powder, or poulticed if they are sloughy and not suppurating freely. To simply abraded surfaces evaporating lead lotion may be applied. The affected part must be kept at rest. If a limb be involved it should be raised. No application seems to better suit the parts—the actual seat of a lymphangitis—than an evaporating lead and spirit lotion, or the free application of belladonna. Any severe tension, and any suppurative focus, should at once be relieved by free incision; and at some hospitals the practice obtains of still applying cold after the matter has been evacuated.

Quinine should be given, and to this drug perchloride of iron may be added in a few days. Any swellings that may persist will probably be relieved by position, by friction or *massage* of the parts, or by the continued application of the elastic bandage. Frederick Treves.

LYMPHOMA. *See* Lymphadenoma.

LYMPHORRHŒA or LYMPHORRHAGIA.—These terms are employed to denote an escape of lymph upon the surface of the body through an abnormal opening in a lymphatic vessel. In almost every wound lymphatics must be cut and lymph escape. The fluid, however, being translucent and very trifling in amount, and mixed at the same time with blood, is not perceived. The flow of lymph from a wound, moreover, would appear to very soon cease. In wounds of large lymphatic trunks, as in a punctured wound of the groin, where no blood-vessel of any size has been pricked, the escape of lymph may be sufficiently copious and sufficiently long-continued to attract attention. Instances, however, of this occurrence are exceedingly rare. In lymphorrhœa the discharge of lymph is very copious. It comes away in drops, and many ounces, and even several pounds, may escape in the course of twenty-four hours. It is probable that in every case there is some abnormality or disease of the lymphatic system. The state of the lymph-vessels may be similar to that of the blood-vessels in hæmophilia, or there may be some obstruction in the tube above the seat of the fistulous opening. With regard to this latter point, it may be noted that lacteals have been found ruptured after closure of some of the main vessels by the pressure of a tumour; and immense quantities of chyle and lymph have been thus poured into the peritoneal cavity. In by far the greater number of the cases of lymphorrhœa the involved vessels are dilated or varicose (*see* Lymphangiectasis), and, indeed, comparatively few cases of lymphorrhœa have been reported where this condition of the vessels has not been apparent. Lymphorrhœa has occurred after wounds, after slight operations such as venesection, after the opening of abscesses, and after incisions into inflamed and enlarged glands. It has occurred also from the surface of an ulcer.

In many cases varicose lymph-vessels have ruptured spontaneously, or have been cut into—when very large—under an erroneous impression as to their nature. Lymphorrhœa has followed the spontaneous bursting of a gland-abscess, and of small purulent collections the result of suppurative lymphangitis. The condition has been most frequently met with in the lower limb, and especially in the groin or thigh. The lymph escapes drop by drop, in the form of a clear, colourless fluid, which may sometimes have a faint yellowish or reddish tint, and occasionally an opalescent appearance. It usually flows more freely during movement and when the patient is standing. It varies in quantity from time to time without apparent reason. In certain instances as much as five pounds is said to have escaped in twenty-four hours. More usually, the amount escaping in a day would be a matter of ounces. The fluid coagulates into a flimsy clot, and hangs from the wound like a whitish fungus. In one or two instances of lymphorrhœa from the scrotum or groin the escaping fluid has been milky, and in these cases some abnormal communication with the lacteals or the thoracic duct has been assumed.

Lymphorrhœa only affects the health when it is profuse and long-abiding. When due to wound and involving a normal vessel, the discharge very soon ceases. When, however, the vessels are dilated or varicose, and when the abnormal opening has formed spontaneously, a very troublesome fistula is apt to be left, which may become more or less permanent.

In *treating* these cases, the limb should be raised and the part placed at rest. The skin should be kept cool, and the extremity compressed by an elastic bandage lightly applied. The fistula may be induced to close by long-continued pressure, applied by means of a truss or a pad and bandage; or, failing this, its margin may be touched from time to time with the actual cautery. Beyond this little can be done, and any attempt at a plastic procedure would probably end in failure. The patient's strength should be supported by tonics and a liberal diet. Frederick Treves.

LYMPHO-SARCOMA. *See* Lymphadenoma.

LYMPH-SCROTUM. *See* Elephantiasis Arabum.

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